THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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GUARDING THE THIRD RAIL.

THE very real dangers of the "third rail" and the necessity of guarding it as far as possible have been clearly brought out by the various accidents which have recently taken place on the Lancashire and Yorkshire and North-Eastern Railways. We have always urged the necessity for most careful investigation of local conditions, and especially of the difficulties which would be encountered by the installation of a third rail on main lines, particularly in stations and at junctions, before deciding on the third-rail system.

In connection with the dangers of the third rail, there are practically three classes of people who have to be considered: first, the ordinary passenger or other person who crosses the railway in defiance of all rules to the contrary, and who may come into contact with the third rail and hence suffer damage; in this case a trespass has been committed, and as the sufferer had no right to cross the permanent way, the third rail is not to blame if an accident happens to him. To the second class belong the officials—porters at stations who frequently find it necessary to cross the lines, and with these must be included the shunters and yard men whose business keeps them constantly on the track. To all of these the charged third rail is a source of continual anxiety unless it is guarded in such a way as to be rendered practically harmless.

As far as these men are concerned, the portions of the line on which they have to work are generally clearly defined, and it is therefore quite possible under ordinary conditions to guard the live rail on such sections in such a way as to render it practically impossible for any harm to be done to the men there employed. At certain complicated junctions and crossings, however, and in stations and goods yards, the addition of a third rail (and possibly a fourth as well) may render matters so congested, and reduce the space available to such an extent, as to make it a practical impossibility to provide an adequate guard for the live third rails.

Unfortunately, it is in these very places that some form of guard is most necessary. In its absence, the live third rail becomes a permanent danger to the officials, and will result in delays, and consequently increased cost of working. Possibly, also, accidents may be brought about by the fact that the men, in their anxiety to avoid the live rail, may not be sufficiently on the look out for approaching locomotives or cars which are being shunted; in places, however, where the third rail cannot be guarded by mechanical means, it may, of course, be specially treated, possibly by employing some system which will render it dead, except when a train is passing over it.

The third, and in some ways the most important, set of people who have to be protected are the permanent way men. In this connection Mr. Merz's evidence before the Board of Trade inquiry, which was fully reproduced in our issue of August 26th, is of great interest. He states that "the permanent way men consider it most desirable that the protection

should be made removable, and if it was made removable, and were removed in the case of working on the line, it would, of course, be of no use as a protection to those particular men." Now, this is a point which we consider most important in connection with the third-rail systems on our main line railways, particularly on those portions on which electric traction must eventually be introduced. If the rapid transit problem is to be properly solved, the amount of time available for keeping the permanent way in order will be very small. Even under ordinary conditions, without the presence of the charged third rail, the platelayers' work is very risky owing to the rapid succession of trains; fishplates have to be tightened up, wooden wedges driven home, chairs attended to, ballast packed under sleepers, &c. The distance between the third rail and the track rails is necessarily very small, and where wooden guards are erected it will be so decreased as to make it very difficult for the platelayers to carry out their work, and consequently the cost of maintenance of the permanent way will be greatly increased. If, in order to increase the available working space, the guard boards are removed, the danger of short-circuits and shocks is greatly increased; the mere slipping of a spanner would be nearly certain to cause a short-circuit, which in itself might result in serious damage to the workman by whose hands the spanner was being worked.

There are certain places where possibly a third rail might be advantageous, as, for instance, in terminal stations, and under certain other conditions such a form of construction might be absolutely essential; but at the same time we firmly believe that for ordinary lines the overhead single-phase system is the only one which will find general introduction on our railway systems. We have carefully considered the whole case, and we do not think that the third-rail system will be generally extended in this country. At the same time, it must not be overlooked that a large amount of money has been spent by the Underground Electric Railways Co. in London, and by the Lancashire and Yorkshire and North-Eastern Railway Companies in the North, and it cannot be expected that these companies will be in a hurry to change those lines already equipped on the third-rail system; but, owing to fortunate circumstances, this will not be a serious matter, and will not prevent the introduction of the overhead system as continuations of those third-rail systems which may have been already constructed. In this connection it is interesting to note that at the present moment three of the largest manufacturing companies, viz., the British Westinghouse Co., the British Thomson-Houston Co. and the Allgemeine Elektricitäts Gesellschaft are all prepared to install single-phase systems so arranged that the same motors and equipments can operate indifferently with a 500 or 600-volt direct-current system, and with a high-pressure single-phase alternating system.

The alternating conductor system of the future will undoubtedly have to be of the high-pressure type. It will also have to be constructed on entirely new lines, and not resemble in any way the trolley wire systems with which we have now become so familiar in connection with ordinary electric tramways. We believe that the Board of Trade and its advisers are fully alive to the requirements of the case, and that when the necessity arises to equip the high pressure system, they will not in any way hinder the railway companies who may be anxious to introduce this novelty, but will rather assist them and allow the companies to equip some experimental lines, so as to enable the Board of Trade to ascertain from actual experiments what rules and regulations will have to be issued in order to safeguard the public interests.

ELECTRICAL LAW IN THE COLONIES AND INDIA.

We publish elsewhere in this issue the first part of an article by our legal contributor, in the course of which he will set forth, in so far as space will admit, the general effect of electrical legislation in the Colonies and India. It is hardly necessary to suggest why an article of this nature may be useful to readers of the Review. Just as the English statute book is a map which shows the progress of each by-road that eventually joins the highway of English enterprise, so the statutes and ordinances of the Colonies indicate the lines along which advancement may be traced in the various countries which go together to form Greater Britain.

In considering the electrical legislation of each of the more important Colonies, it is intended to show whether and how far the supply of electricity for light and power has been placed under statutory control. A knowledge of this fact may be of the greatest importance to anyone who, in the effort to establish electrical trade connections abroad, must fain look to the dependencies of the Empire for a new field of enterprise. Further than this, a compendious statement of the law of electricity in every important colony may be of use to the legislature of any colony which has not yet considered it expedient to make any special legislation on the subject.

Passing on to consider the general impression which the article now commencing has made upon us, it appears, and indeed it was only to be expected, that a strong flavour of English electrical legislation permeates that of the Colonies. Indeed, in some instances, all the material provisions of the Electric Lighting Acts, 1882 to 1899, have been transcribed with a few modifications of a strictly local nature into the Colonial statute book; while, in one case, in prescribing the regulations which the Governor in Council may make with regard to supply, a Colonial governing body has considered it sufficient to say that such regulations shall follow those of the English Board of Trade! Admirable as much of our own electrical legislation has proved to be, we cannot but regret that many of the Colonies have followed those parts of it which, in this country, have done so much to check and hamper the development of electrical enterprise. Thus the principle of *veto* by the local authority has often been introduced; while the right of compulsory purchase has in many cases been conferred. It is but due to say, however, that this right is generally postponed for a long period of years.

It must not be taken that Colonial governing bodies have always blindly followed the Mother of Parliaments. In India, for instance, and in one or two Colonies, there has been a signal departure from English principle. Thus it is well known that in this country, although a provisional

order is generally obtained, electricity can be supplied by one person to another for light or power without Parliamentary sanction. In India and the Colonies referred to, supply of any kind is forbidden, except with the sanction of the legislature or some order in Council.

From the point of view of the Colonies themselves, it is difficult to conceive any more important subject for exact and broad-minded legislation than electricity. In our own islands, the use of electricity has been established in the teeth of vested interests, with a perpetual difficulty of obtaining wayleaves, and in opposition to claims for which the Lands Clauses Acts provide but a tedious and costly settlement. Among the broad acres of the Colonies, however, this modern means of diffusing light and power can be made the pioneer of, not the mere attendant upon, civilisation; the electric main, which brings a never-failing supply of power from the waterfall, or the power station situated within easy reach of the coalfield, can be laid in virgin soil, not beneath the pavement of an ancient highway.

It is hoped that the article now commencing may have the effect of drawing attention to the necessity for enlightened legislation in all the Colonies, and to the desirability of not putting off that legislation any longer than can be helped.

Electric Winding.

WE have received an interesting brochure on "Electric Winding" by Mr. G. H. J. Hooghwinkel, in which he discusses the advantages of electric winding, and describes some of the different systems which have been adopted in Germany. Mr. Hooghwinkel evidently holds a brief for electric winding, and is scarcely fair to the poor old steam winder, which has done such good service in the past, and could do so very much better if it only received the same attention as its rival. British engineers, however, will require considerably more evidence than that given by the author to convince them that the steam consumption can be reduced to *half*, and at the same time the output *doubled*, simply by adopting electric winding. Such a statement is absurd. The difficulty at most collieries in this country with regard to output is not in the steam winding plant, but in getting the coal to the pit bottom in sufficient quantity to keep the winding apparatus in full swing. If an electric winder were adopted, it would have to "wait on" in exactly the same way.

Steam winding engines in this country can be installed which consume something like only 30 to 40 lbs. of steam per hour per indicated horse-power. Mr. Hooghwinkel in his comparison, however, assumes that the steam winding engine will consume 90 to 100 lbs. per actual horse-power-hour, which is too much by about one-half. Many engines *are* extravagant in steam consumption, but they are bad ones! To be quite fair, electrical winding plants ought to be compared with the best—not the worst—steam winding practice. Admitting, however, that there may be some economy in fuel by adopting electric winding, what the mining engineer would like to know is, Will it be quite so serviceable? The electric winding plant at Zollern II. Colliery is again held up as an example to the British engineer, but whilst he no doubt admires the excellence of the arrangements, he also very much regrets that he cannot get the price for his coal to enable him to fit up his colliery so expensively.

Electricity—the Scapegoat.

FOR the benefit of a large circle of general readers, we have, on several occasions, urged the necessity of receiving with caution the frequent reports of fires whose occurrence is alleged to be due to defective electrical wiring and similar causes.

That such a warning is needed is only a natural outcome of the irresponsible statements of a daily Press, which so eagerly seizes on any item of electrical news, good, bad or indifferent, as specially suitable for present-day consumption. How far from the truth many accounts of fire origins may be, is well illustrated by a recent quarterly report of the Electrical Bureau of the National Board of Fire Underwriters (U.S.A.), which once more proves that many fires attributed to the scapegoat electricity, have turned out, on careful inquiry, to be due to other causes. The report shows that 145 actual electrical fires occurred in America aggregating a loss of $172,000; a further 107 fires, with losses of some $13,611,900, are mentioned (one of which occasioned a loss of $12,000,000), but as these could not be definitely proved to be of electrical origin, they are not included in the report. Thirty-nine fires, aggregating some $250,000 loss, reported as due to electricity, have been definitely proved to be due to other causes, among them being fire-places, gas-stoves and jets, defective flues, &c. These figures could doubtless be amplified from other reports, but they will serve the purpose of showing the mistaken character of unqualified opinion in regard to fire outbreaks.

In this connection it may be interesting to refer to some figures relating to fires in the U.S.A. given by the Italian paper *Il Gaz*, and quoted with evident relish by our contemporary, the *Gas World*, some few months ago.

The figures in question were supposed to show that damage from electrical fires had increased from 4 to 16 million dollars during the years 1900 and 1901 respectively, whereas we note that the various gas systems during the same periods were only accredited with fire damages of 2 and 4 millions of dollars respectively.

Now, bearing in mind the extremely questionable accuracy of the totals for fires attributed to electrical causes, as exemplified by the report of the National Board of Fire Underwriters, quoted above, it seems probable that, as usual, the losses by fires of electrical origin are greatly exaggerated.

Then, again, the figures lose any value which unquestioned accuracy might have given them, when considered in conjunction with the relative use of gas and electricity in the States, a matter upon which our contemporary was discreetly silent.

From the United States Government returns for 1903, we find that some 3,700 electrical plants were in operation for supplying light and power (exclusive of electric railway and tramway plants) and only some 900 gas plants; moreover, the figures take no account of the 40,000 to 50,000 isolated electrical plants, without which no modern American building of importance is considered complete. In fact, we feel justified in believing that to the universal use of electricity in American buildings, and to the impossibility of tracing to their origin, fires of any magnitude, is due the only too prevalent fashion of branding fires indiscriminately as of electrical origin. The fact that electrical circuits in buildings are for the most part adequately protected against overloading of a dangerous character, such as might occur from accidental short circuits or similar failures, and that the majority of gas installations are practically unprovided with a means of cutting off the supply in emergency (as was recently demonstrated in Piccadilly) might, if better understood, serve to modify popular opinion as to the relative safety of gas and electricity as illuminants. It is on record that fires of insignificant dimensions have extended with disastrous results under the influence of a leaky gas supply which could not be cut off.

THE SMALL ENGINE OF LARGE POWER.

By HORACE ALLEN, C.E.

The modern motor-car and motor-cycle owe their existence to (1) the improvements in machine tools, and (2) the increased number of revs. per min. obtainable in reciprocating engines of small size, through the more perfect workmanship resulting from the employment of more exact methods.

Though the above remarks apply to all classes of small size engines of the present day, the small cylinder internal combustion engine probably presents the most interesting study, owing to its simplicity and its very general adoption.

It will be obvious that the perfecting of the small engine of large power will lead to its application in many other directions than for traction purposes, so it behoves us to become familiar with the most important features of this class of power generator, to enable us to consider its adoption for the driving of electric generators, &c., as well the limits of increase of power possible in this class of machine.

The least costly method of increasing the power of an engine is that resulting from the increase in the number of revolutions in a given period of time, and this is chiefly controlled by the *piston speed* permissible.

The more perfect methods now employed in the engineering shops have rendered practicable a normal piston speed as high as 1,125 ft. per minute for small cylinder internal combustion engines, while large cylinder gas engines are now run at from 800 to 900 ft. per minute; but in the former case the number of revolutions can be as high as 2,500 while the latter range from 50 to 200 r.p.m. The difference in the speed of revolution in the above-mentioned engines is due to the necessity of proportioning the *stroke* to the *diameter* when designing engine cylinders. The present practical limit to the speed is about 2,500 r.p.m., for at higher speeds ignition becomes uncertain and loss of fuel results.

With speeds of 1,500 to 2,500 r.p.m., the diameter of the cylinder is so small that a high power engine would have to be provided with a large number of cylinders; this in itself, however, would not be a disadvantage for driving alternators or other machines requiring a high cyclic regularity.

Prof. Callender has proved that a cylinder having a piston displacement of 12 cb. in. is capable of developing 2¼ I.H.P.

When this small type of cylinder is adopted, it will be obvious that friction becomes a serious source of loss of power, and for this reason all the most perfect methods of reducing it must be made use of, such as balls or rollers for bearings, and grinding and polishing all rubbing surfaces to the highest possible degree, as well as the most perfect lubrication by oil of a high quality.

Another important factor to be taken into consideration when designing engines to run at a high number of revolutions is the effect of inertia, especially on the valves, piston, connecting-rod, &c., rendering it necessary to make all these parts as light as can possibly be accomplished.

The frequency of the ignitions, and the intensity of the heat resulting from the rapid combustion in cylinders running at such high speeds as 2,000 to 2,500 r.p.m., necessitate the effective application of some suitable cylinder-cooling method, and special attention must be paid to preventing any projecting points in corners, which might become so heated as to cause pre-ignition, as well as recesses where hot gases might be retained, causing the same defect.

The disturbing effect of inertia has been referred to, and this must be taken carefully into consideration in designing the reciprocating parts of the engine; but another element, sometimes causing trouble, also results from the rapidly revolving parts of the machine, and that is the gyroscopic effect.

In the case of a motor-boat, it is found that as the shaft and engine revolve in the line of progress of the vessel, the gyroscopic action causes it to resist the tendency to follow the motion of the waves, and to shoot straight through them in a direct line, thus preventing the boat from properly bedding down in the water. In the case of motor-cars there is, no doubt, somewhat of a similar effect arising from the gyroscopic action; in motor-cycles, however, the driving shaft is generally arranged so as to be *across* the direction of motion instead of in line with it, thus adding to the stability of the cycle to some extent.

VISIT OF THE INSTITUTION OF ELECTRICAL ENGINEERS TO AMERICA.

[BY OUR SPECIAL COMMISSIONER.]

In accordance with the programme previously arranged, about 60 members of the I.E.E. sailed from Liverpool in the White Star liner ss. *Republic*, on August 25th, and arrived in Boston on September 2nd, after a pleasant passage. A prolonged voyage of this description has the especial advantage that members of the party are able to renew old acquaintances and make fresh ones, so that on landing in America their relations to each other are not those of entire strangers, a fact which adds much to the comfort of a party travelling together.

Mr. Robert Hammond, the hon. treasurer of the Institution, acted as chairman on the voyage out; Mr. R. Kaye Gray, the president, together with the secretary of the Institution, Mr. G. C. Lloyd, having gone on in advance so as to see that all arrangements were complete before the arrival of the main party.

On the voyage out, sports were organised on two successive days, in which borough electrical engineers, contractors' and manufacturers' engineers competed with each other, and consulting engineers and directors of companies acted as judges, all for the nonce laying aside their dignity. Also a concert programme and a dance were arranged and carried out, in the former of which the Institution comb band played a prominent part. On these occasions collections were made for Liverpool and New York seamen's charities, amounting to over £40.

During this voyage the first two visits of the tour were made, namely, to the engine room and to the ship electrician's cabin, small parties being formed for that purpose each day.

The main engines, driving twin propellers, were of the quadruple expansion type, built by Harland & Wolff, of Belfast. The cylinders were 29 in., 41½ in., 61 in., and 37 in. diameter, and the length of stroke 60 in., r.p.m. 78, the I.H.P. being about 11,000. The coal consumption was about 1¾ lbs. per I.H.P. with average coal, a figure obtained under the good condition of running which is the ideal of the electrical engineer—namely, a load factor of unity. The boilers were eight in number, four double-ended, and four single-ended; the working pressure was 200 lbs. per sq. in. The total consumption of coal each day is about 200 tons, and the coal bunkers have a capacity of 4,600 tons, the total cargo capacity of the ship being about 16,000 tons.

To prevent racing in rough weather, an Aspinall governor is fitted to the air pump levers, which acts on the throttle valve. Thirteen auxiliary engines are provided for pumping, &c. The total weight of machinery is approximately 1,900 tons. The average rate maintained by this vessel at sea is 16 knots.

The ship was lighted throughout by electricity, the plant consisting of two high-speed open-fronted engines and bipolar dynamos, each having an output of 450 amperes at 60 volts when making 300 r.p.m.

In the electrician's cabin Mr. Hope-Jones, of the Synchronome Co., who was one of the party, had fitted up a set of his synchronome clocks, which he was taking over to the St. Louis Exposition. In this system a master-clock, which is automatically wound by electrical means, sends a current every half minute around the electro-magnets of a number of ingenious and simple mechanisms, fixed behind clock dials, which operate the hands on these dials in unison with each other and with the master clock, the object of the system being to ensure that all the clocks in a large building keep uniform time without needing individual attention.

A very interesting instrument also on view was a recording voltmeter, to which Mr. Hope-Jones's system had been applied. The pens of the usual recording voltmeters and ammeters give a good deal of trouble to the attendants in keeping them in order, more especially when these instru-

ments are used on traction circuits, where the variations in the record are often great, and occur at frequent intervals. In the instrument referred to, the pointer does not touch the paper on which the record is made, except at half-minute intervals (or at more frequent intervals if desired), when a bar automatically presses the pointer tip on to a type-writer ribbon, which is placed just above the record paper, and thus a dot is marked on the chart. A very clear diagram is thus obtained, formed of a series of dots, free from any smudges through excess of ink, or blank spaces due to the failure of the ink-feed.

An informal reception had been arranged for on the landing pier, but the ss. *Republic* arrived early in the morning, ahead of her scheduled time, so this arrangement had to be given up. The Boston Reception Committee, represented by Messrs. C. H. Hodgkinson and G. H. Lyman, together with Mr. G. C. Lloyd, secretary of the I.E.E., met the steamer at the entrance to the harbour, in the Customs officers' launch, and Mr. R. Kaye Gray, the president, met the party at the landing-stage. The Boston Committee was able to facilitate the passage of the luggage through the Customs, without the usual obnoxious delay and red tape, so that it was not long before the party were able to drive off to the Hotel Vendome, which was their head-quarters during the stay in Boston.

No official arrangements had been made for the afternoon, owing to the unforeseen early arrival of the visitors, so Mr. C. L. Edgar, Chairman of the Boston Reception Committee, suggested a visit to see an example of the American national game of base-ball that was to take place that afternoon between two well-known teams, Boston and Cleveland. This invitation was accepted by a number of the party, who had a very interesting experience, watching what to them was a novel game. Others took the opportunity of making a tour round the city and suburbs in one of the tramcars, which are run especially for that purpose by the tramway company; a guide with a megaphone accompanies such cars and points out the objects of interest *en route*. Such a tour gave a very good idea, not only of the city and its suburbs, but also of its marvellous "street railway" system. Such a multiplicity of lines and quick-moving cars must be of great convenience to the inhabitants. The poor construction of the roads, and the careless way in which the rails were laid, excited a good deal of comment from the party; they found, however, as they visited other cities, that this was typical of tramway practice in the States.

Late in the afternoon the delegation of the Associazione Elettrotecnica Italiana arrived at Boston, having travelled up from New York, where they had arrived a few days previously, to meet the English party.

The official commencement of the visit after landing in America was the reception, followed by an informal supper given at nine o'clock in the evening to the visitors at the Hotel Vendome. Mr. C. L. Edgar, chairman of the local committee of the American Institute of Electrical Engineers, after welcoming the visitors on behalf of the Institute he represented, introduced Governor John L. Bates, who, in the course of his address of welcome to New England, said that Massachusetts, as the centre of Yankee-land, the home of inventive genius, was glad to have the privilege of receiving them as representatives of a profession which had done so much for New England. He mentioned that, in Boston, a greater percentage of incandescent lamps was used per head of population than in any other city. It was a city that had also early solved its transportation difficulties by the aid of elevated, surface, and underground railways, all combined into one system, and working harmoniously together. He also stated that Massachusetts, as the birthplace of Benjamin Franklin, Samuel Morse and Cyrus Field, and the home of Bell, was particularly fortunate in being able now to be the first to welcome in its leading city the scientists, electricians, and electrical engineers from Great Britain and Italy. Mr. R. Kaye Gray then returned thanks on behalf of the British Institution for the warm welcome they had received, being followed by Prof. M. Ascoli, President of the Italian Association, on behalf of his countrymen.

On Saturday, September 3rd, the visitors were driven in automobiles to view the new turbine station of the Edison Electric Illuminating Co., of Boston, who have gradually acquired the electric lighting of the metropolitan district of Boston, and consequently are displacing the small stations by the huge station referred to above. Owing to the peculiar conditions affecting the supply due to the incorporation of smaller companies, three different bus-bar voltages are maintained, namely, 15,000, 6,900, and 2,300 volts. Current is distributed to the outlying districts by means of underground cables through the city proper, and beyond that by aluminium overhead wires. A very extensive coal storage system is provided here, as they take in their coal supply for the year in the summer months, when prices are low and navigation is unimpeded by ice.

The power station is divided into two main buildings, one containing the older reciprocating engine type of plant, and the other, which is in course of erection, turbine plant. The older station has a capacity of 12,000 KW. in low-pressure continuous current plant, supplemented by a storage battery of 1,456 KW.-hours, from which current is supplied directly in the vicinity. The remainder of the low-pressure direct-current customers are supplied from rotary converter sub-stations, which, in their turn, are supplied from alternating current plant having a total capacity of 10,500 KW. in three-phase generators of 1,500 KW. at 2,300 volts and 60 cycles. The turbine station is planned for the installation of twelve 5,000-KW. units, of which, at present, only one is running. The boilers in this station are arranged in rows at right angles with the turbine room, the wrought-iron main steam pipe running underneath each group of boilers, and going directly to the turbine in line with them. The stop valves are operated by electric motors, and can also be operated by hand from the other side of a partition, so that they can be closed in the event of breakage, without any danger to the operator owing to the escape of steam.

The turbines are of the Curtis four-stage type, of the newer pattern, which have the surface condensers mounted directly under the generator, thus greatly economising the floor space. The space occupied is less than one-half that required for one of the 1,500-KW. units in the old station. The generator for each is of the revolving field type, 60-cycle, three-phase, wound for 6,900 volts, 514 r.p.m. The total weight above the condenser is 115 tons. The footstep bearing thrust is carried under a hydraulic pressure of about 900 lbs. per sq. in. The presence of the auxiliaries—namely, centrifugal circulating pump, air pump, centrifugal hot-well pump, hydraulic pumps, hydraulic accumulator, and boiler feed pumps—makes the unit look more complicated than it really is. The turbine generator, though practically vibrationless, gives out, together with its auxiliary machinery, a good deal of noise.

A separate switch-house is under construction between the turbine house and the old power house, from which all apparatus can be controlled, though very little of it is in sight, a feature that seems to be becoming a necessity in the large plants of the present day. The main switches are all of the General Electric Co.'s quick-break oil type, motor-operated. The field rheostats were also motor-operated. The bus-bars, which were mounted in brick-built cells with concrete shelves, were made of aluminium, since the current-carrying capacity required was not large and copper bars would have been too small to be practicable; under the circumstances aluminium was found to be the cheaper of the two, and was accordingly used. The bus-bar space under the switchboards is a dry place, so that there is no fear of bad contacts due to any oxidation that may take place; moreover, renewable strips are placed as a precautionary measure in all contacts, which could be replaced in the event of any such trouble.

The chief telephone exchange of the American Telephone and Telegraph Co. was next visited. The switchboards, with lamp signalling, are similar to those installed at the London Post Office telephone exchanges; the subscribers' calls, however, are not registered by meter, slips of paper being filled out by the operators instead. In connection with the handling of these pieces of paper, a very ingenious pneumatic transfer system was being installed to carry them to the registering clerks' desks. Though lead-sheathed paper cables are used, and notwithstanding the fact that Boston is not at all a dry place, air pumps are not used for drying the cables.

Leaving the Exchange in automobiles the guests were driven, *viâ* the Park system, to Harvard University, which

is situated a few miles outside Boston, standing in its own magnificent grounds. There they were joined by the ladies of the party, for whom the Boston Reception Committee had made special arrangements, taking them out for a motor ride to see the principal points of interest, while the men were visiting the power station and exchange. The whole party were met at Pierce Hall, Harvard University, by Dr. A. E. Kennelly and some of his colleagues, representing the University. Several of the colleges and halls were viewed, including Jefferson physical laboratory, the electrical engineering laboratory, the museum, the memorial hall and Germanic museum. Dr. H. P. Wolcott, representing the Corporation of Harvard College, then received the visitors at Harvard Union, where lunch was served. To Dr. Wolcott's address of welcome Mr. R. Kaye Gray and Prof. M. Ascoli responded, expressing their thanks on behalf of the Institutions they represented.

Soon after three o'clock special tramcars, provided through the kindness of the Boston Elevated Railway Co., conveyed the party to the Massachusetts Institute of Technology, where they were received by Prof. H. E. Clifford Lawes and others representing the Institute, and then shown over the laboratories. The size of the new electrical laboratories especially surprised many of the visitors; they looked more like an electrical engineer's workshops, the apparatus being so large and covering so much space. A special feature of the arrangement of the lecture room was the tables running on rails leading from the preparation room, on which comparatively heavy machinery could be placed for class demonstration purposes. An ingenious method of using line diagrams to explain dynamo and motor circuits, &c., is employed here, the diagrams being made out on a large scale on wooden boards, and to the correct points on the diagram the actual connections of the machine being experimented with are attached; thus the elementary student can more easily understand that the connections on line diagrams and on the actual machine are one and the same thing, a point that it is difficult to grasp at first. Also the connections can be easily altered on these diagrams in the presence of the class, and thus they can see what is happening, instead of taking the connections on faith.

The afternoon train was taken to Fall River, and from there the night boat to New York, the party arriving early in the morning, when they were driven to their headquarters in New York, the Hotel Waldorf-Astoria, in automobiles. In the afternoon a number of the party accepted an invitation from Mr. J. G. White for a steamboat excursion on the Hudson River and down to Coney Island.

(To be continued.)

ELECTRICAL LAW IN THE COLONIES AND INDIA.

[FROM OUR LEGAL CONTRIBUTOR.]

The spread of electrical enterprise throughout the British Empire naturally turns the attention of English manufacturers of electrical machinery to the markets of India and the Colonies. Inasmuch as the field for development in the British Islands is rapidly becoming smaller owing to district after district being equipped with the necessary plant for the production of electricity for distributing light and power, it is necessary for manufacturers to look further afield.

Although questions relating to the legal authority under which electricity may be supplied are of local rather than of imperial interest, it may sometimes be important for those who are connected with electrical manufacturing to be informed as to how far, and by what authority, electricity may be supplied in various parts of the Empire. Such information, especially with regard to our more distant and less well-known dependencies, is not easily obtained. No doubt copies of every Act and ordinance may be seen and studied at the Colonial Office; but those august precincts are not within the reach of all. Further, in order to find all the legislation concerning electricity in any particular colony, it is necessary to wade through all the statutes and ordinances of the colony; for it often happens that earlier measures are much modified by later legislation. They have not been dealt with because information respecting them has not been within the writer's reach.

In these circumstances the following synopsis of electrical legislation in the more important colonies of the Empire may be found useful to readers of the Electrical Review. It does not purport to be an exhaustive treatment of all the material statutes and ordinances relating to electricity which have ever been passed in every dependency. Thus, it makes but casual reference to the various measures which have been rendered necessary for the purpose of introducing the use of electrical power on tramways, and it does not deal in any way with telegraphic or telephonic legislation. It is hoped, however, that the summary will be useful to any person who desires to know something of the law relating to electric light and power in all the more important Colonies.

In accordance with the above objects, the following states and dependencies will be found to have been dealt with (in alphabetical order):—I. Australia, including (*a*) New South Wales; (*b*) Queensland; (*c*) South Australia; (*d*) Victoria; and (*e*) Western Australia. II., British Columbia; III., British Guiana; IV., Canada, including (*a*) New Brunswick; (*b*) Ontario; (*c*) Quebec; V., Cape Colony; VI., Ceylon; VII., India; VIII., Jamacia; IX., Natal; X., New Zealand; XI., Southern Rhodesia; XII., Tasmania; XIII., Transvaal; XIV., Trinadad and Tobago.

With reference to colonies and dependencies of the Empire which are not included in the above list, the reader should not infer that the reason for their omission is the absence from their respective statute books of electrical legislation.

I. *Australia.*—Speaking with reference to all the States, electrical legislation in the Commonwealth of Australia may be said to be in a fairly advanced condition. It is somewhat extraordinary, however, that there does not seem to be any general statute relating to the supply of electricity in New South Wales. Possibly some such measure may now be under consideration. Matters seem to have proceeded further in other parts of the Commonwealth. Thus the legislatures of Queensland and Victoria have considered it expedient to prohibit the supply of electricity except under statutory authority. In this respect they have gone considerably beyond the English Electric Lighting Acts, which, as readers of the Review are probably aware, are enabling only, and do not prohibit the supply of electricity otherwise than under the terms of a provisional order.

I. (*a*) *New South Wales.*—There does not seem to be any general legislation relating to the supply of electricity on the statute book of New South Wales. The treatment which is likely to be accorded to electrical undertakers, whether private or municipal, may, however, be gathered from the Municipal Council of Sydney Electric Lighting Act, No. 23, of 1896. That Act is entitled "an Act to enable the Municipal Council of Sydney to light the streets, also public and private places of the city of Sydney with the electric light, and also places outside the said city, and to exercise all powers necessary for such purposes, and for the above purposes to raise by debentures the sum of £250,000." Sec. 3 of the Act provides that "it shall be lawful for the Council to generate and supply electricity for any public or private purposes, or for any public purposes, and any private purposes within the limits of the city of Sydney. Provided that electricity may be supplied outside the said limits in manner hereinafter set forth." Secs. 14—18 confer upon the Council the right to break up streets, &c., for the purpose of laying their installation. In the course of this work they are bound to give all the notices, &c., which are rendered obligatory upon undertakers who supply electricity under provisional order in this country. Sec. 19 contains a provision to the effect that in the exercise of their powers the Council must do as little damage as possible, and must pay compensation for all damage. A similar clause appears in provisional orders in England; but the statute under notice contains the following proviso:—"Provided that the Council may in all cases be at liberty to set up by way of defence or in mitigation of damages, as the case may be, that the person claiming compensation has by his own act, neglect or default caused or contributed to the damages

in respect of which he claims to be compensated." The provisions of this Act, which render it obligatory upon the Council to furnish a supply "without fear or favour," follow closely upon the lines of our own Electric Lighting Acts.

I. (*b*) *Queensland.*—The list of statutes in force in Queensland, which was published in 1901, only contains a reference to one Act relating to the supply of electricity for light and power. We refer to "An Act to facilitate and regulate the supply of electricity for lighting and for other purposes" (1896, 60 V., No. 24). Prior to this date, it appears that the supply of electricity was only regulated, if at all, by one or two private Acts.

The Act of 1896, which appears to be modelled upon the English Electric Lighting Acts, is divided into parts as follows:—(1) Preliminary; (2) Constitution of Electric Authorities; (3) Powers, Duties, and Obligations of Electric Authorities; (4) Protection of Government Telegraph Lines; (5) Supply of Electricity and Recovery of Charges; (6) Purchase of Undertaking by Local Authorities; (7) Regulations and Bye-Laws; (8) Offences; (9) General Provisions.

The term "electric authority," as used in the Act, signifies any local authority, company, or person, authorised by an order granted under the Act to supply electricity within any prescribed area.

(1) *Preliminary.*—Sec. 4 embodies a principle which, we are glad to say, is foreign to our own law. It provides that: "From and after the passing of this Act, and subject only to the provisions in this part of this Act hereinafter contained, no local authority, company, or person shall construct or use any electric lines or works or supply electricity except under the authority of an order made pursuant to this Act.

Provided that this Act shall not apply to any case in which an electric line is not constructed, or used, or electricity is not transmitted or supplied beyond the limits of the buildings or premises in which the electricity is generated." This section has the effect of prohibiting the supply by a private company or person to a few neighbours. Sec. 5, however, makes an exception in the case of persons or companies which, at the passing of the Act, were supplying electricity.

(2) *Constitution of Electric Authorities.*—Just as the Board of Trade has power to grant a provisional order for the supply of electricity in England, the Governor of Queensland in Council may, by Sec. 8 of the Act under discussion: "from time to time by order in council authorise any local authority, company, or person to supply electricity within any prescribed area for such purposes as may be specified in the order, and for such period, subject to the provisions of Part 6 of this Act, as the governor in council may think proper."

Sec. 10 embodies the principle laid down by Sec. 4 of the Electric Lighting Act, 1882, and Sec. 1 of the Electric Lighting Act, 1888, by which the local authority is entitled to notice of the intention of a private company to apply for an order. It is to be observed that although such an order is not to be granted except with the consent of the local authority, the governor in council may in a proper case, dispense with such consent. Sec. 11 provides that the electric authority shall be subject to such conditions, limitations and liabilities as may be inserted in or prescribed by the order affecting the undertaking with regard to a number of matters. To put it generally, the supply is subject to restrictions similar to those which are laid down in the schedule to the Electric Lighting (Clauses) Act, 1899.

(3) *Powers, Duties, and Obligations of Electric Authorities*, and (4) *Protection of Government Telegraph Lines.*—These are practically identical with the corresponding provisions of the English Acts.

(5) *Supply of Electricity and Recovery of Charges.*—This part makes it incumbent upon an electric authority to supply electricity, and prohibits them from prescribing any special form of lamp, or making any undue preference to any consumer.

(6) *Compulsory Purchase.*—The provisions of the Act relating to compulsory purchase are identical with those contained in the Electric Lighting Act, 1888, Sec. 2.

(7) *Regulations and Bye-Laws.*—These are made by the Governor in Council.

Amongst the *General Provisions* (9), Sec. 58, provides that whereon matters in the Act are directed to be decided by arbitration, the arbitrator is to be nominated by the Governor in Council on the application of either party.

I. (*c*) *South Australia.*—Legislation relating to the supply of electricity in South Australia seems to be confined to an Act which was passed in 1891 "to authorise Municipal Corporations and District Councils to supply gas and electricity for lighting and other purposes." This statute is No. 531 of 1891. Part 2 is devoted to the supply of electricity, but many of the provisions of Part 1, which relate to the supply of gas, are made applicable to electricity by making the word "gas" include "electricity," and the word "pipe" include "electric line."

Sec. 49 provides that:—"Any local authority may, subject to the provisions of this Act, supply electricity for any public or private purposes, or for any public purposes and any private purposes, within the limits of its district, or within such other limits as the Governor may from time to time by proclamation in the *Government Gazette*, allow; provided that where such other limits comprise land within the district of any other local authority, such Proclamation shall not be made without the consent under seal of such other local authority."

In supplying electricity the local authority shall be subject to such regulations as may, from time to time, be presented by the Governor by Proclamation in the *Government Gazette*, with regard to the following matters:—

(*a*) The limits within which, and the conditions under which a supply of electricity is to be compulsory or permissive;

(*b*) Securing a regular and efficient supply of electricity;

(*c*) Securing the safety of the public from personal injury, or from fire, or otherwise;

(*d*) The limitation of the prices to be charged in respect of the supply of electricity;

(*e*) Authorising inspection and inquiry from time to time by the governor and any local authority which shall be concerned, other than the local authority supplying the electricity;

(*f*) The enforcement of the due performance of the duties of the local authority in relation to the supply of electricity by the imposition of penalties or otherwise; and

(*g*) Generally with regard to any other matters in connection with the supply of electricity. Note.—The power here conferred upon the governor is very similar to the power to make rules which is vested in the English Board of Trade.

By Sec. 51, the local authority within any part of whose district the electricity is, under proclamation, authorised to be supplied by any other local authority, may, in addition to any regulations which may be made under the provisions of the last preceding section for securing the safety of the public, from time to time make, rescind, alter, or repeal bye-laws for further securing such safety, and there may be annexed to any breach of such bye-laws such penalties as the local authority may think necessary, not exceeding £50 for each offence; provided that no such bye-laws shall have any force or effect unless and until they have been confirmed by the governor, and published in such manner as the governor may direct.

For the rest, it may be taken that this Act follows the broad lines of the English Electric Lighting Acts.

I. (*d*) *Victoria.*—The supply of electricity in Victoria is regulated by the Electric Light and Power Act (No. 1,413) of 1896, as amended by the Electric Light and Power Act (No. 1,694) of 1900. These statutes bear a strong resemblance to those of Queensland, which have already been referred to. They are obviously founded upon the English Electric Lighting Acts.

Sec. 5 of the Act of 1896, provides that:—"No council (*i.e.*, no council of any municipal district), company, or person, shall use, lay, erect, construct, put up, or place, any electric line, or supply electricity for public purposes, or private purposes, except under the authority of an order made pursuant to this Act." This provision is subject to a proviso in favour of those who were supplying electricity at the time when the Act came into operation.

By Sec. 10 it is provided that subject to the Act, the Governor in Council may, from time to time, by order, authorise any council to supply electricity for any public or private purpose within any area, and in the case of any

company or person, for such period *not exceeding 30 years*, as the Governor in Council may think proper.

The Act contains the usual provisions for notification to the local authority of any application to be made by a company or person. The consent of the local authority is generally required, but the Governor in Council has power to dispense with such consent in a proper case.

The provisions of the English Electric Lighting Acts with regard to the breaking up of and interference with highways, and the interference with wires, &c., under the control of the Postmaster-General, seem to have been adopted *in toto* by the Victorian Legislature.

By Sec. 43 a right of compulsory purchase is conferred upon municipal councils.

The terms and conditions upon which this right may be exercised are practically identical with those which are to be found in Sec. 2 of the Electric Lighting Act, 1888. It is to be noticed, however, that the right may be exercised after 30 years, "or such shorter period as is specified in that behalf in the order from the date of the order." The value of the lands, buildings, materials, plant, and works shall be deemed to be their fair market value at the time of the purchase, due regard being had to the nature and then condition of such buildings, materials, plant, and works, and to the state of repair thereof, and to the suitability of the same to the purposes of the undertaking, but without any addition in respect of compulsory purchase or of goodwill or of any profits which may have been or may be made from the undertaking or of any similar considerations.

By Sec. 44 the Governor in Council has power to vary the terms upon which any Council may require the undertakers to sell.

Sec. 52 puts a limitation upon the profits which may be distributed. It provides:—"The profits which may be divided amongst the shareholders of any company being an undertaker under this Act, so far only as such profits are derived from supplying electricity shall not in any year exceed ten pounds per centum on so much of the paid-up capital of such company as has been appropriated for the works or expenditure of such company as an undertaker under this Act. Provided that whenever throughout any half-year any company shall charge for electricity supplied to consumers a less price than the maximum charge fixed by the order authorising the undertaking, such company may increase such rate of dividend for such half-year by one-half per centum on the paid-up capital for each and every reduction of one farthing per unit in the price of electricity."

(To be continued.)

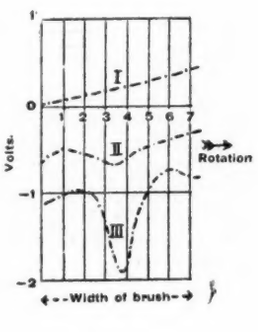

Fig. 3.

EXPERIMENTS ON COMMUTATION.

M. Iliovici recently described before the Société Internationale des Electriciens some experiments carried out by him on the occurrences within the short-circuited section of a direct current dynamo. Since the investigation dealt with low voltages (varying from ·1 volt, in some cases, up to a few volts in others), and with time intervals of the order of $\frac{1}{1000}$th second, the author considered automatic apparatus such as the oscillograph, ondograph, &c., unsuitable, and fell back on Joubert's method with Franke's modified contact maker. This consists of a five-part commutator, four parts of which occupy about 60° of arc each, and the remaining one 120°, and it is fitted with two small brushes separated from one another by almost 120°. During the time (which can be made as short as desired) that the two brushes are connected by the large segment, a condenser is charged with the voltage under test, and during the remaining part of the revolution of the contact maker (which is driven direct from the dynamo under test) the condenser discharges through a specially sensitive D'Arsonval galvanometer. After detailing the precautions taken to ensure accuracy, the author describes some of the results obtained.

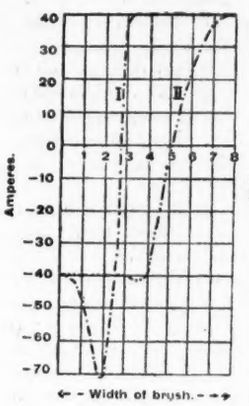

Fig. 1.

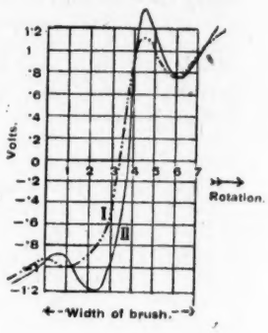

Fig. 2.

Separate tests were made to determine (1) the current variation in the short-circuited section; (2) the variations in the voltage induced in the section; and (3) the variations in voltage drop between the brush and the commutator segment under the brush.

1.—*The Variation in the Current Flowing in a Section during the Short-circuit.*

Two methods were employed for determining the current in the short-circuited section. The first consisted in cutting one of the armature sections at the end remote from the commutator, and

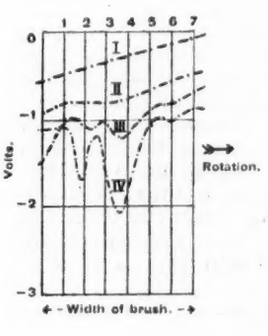

Fig. 4.

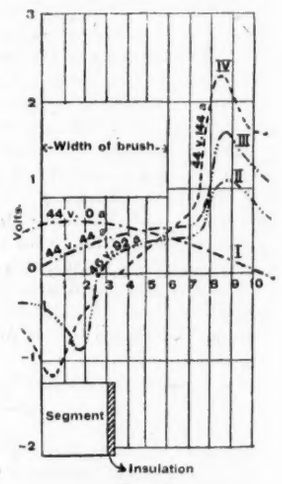

Fig. 5.

leading the two ends to two slip rings. The brushes on these rings were then short-circuited through a non-inductive low resistance, and the voltage drop in this resistance was measured. In order to avoid dissymmetry, compensating resistances, as nearly as possible equal to the total resistance inserted into the cut section, were inserted into all the other sections on the armature. The curves in fig. 1 were obtained by this method, Curve I. being with a load of 40 amperes and 100 volts at 975 revolutions and with the brushes set on the neutral line, and Curve II. at the same load and speed, but with the brushes set about 6 segments (the commutator had 64 total segments) behind the neutral line. The brushes covered 2½ segments. It will be seen that in the first case the reversal of the current does not commence till towards the middle of the time of short-circuit, and reaches the normal reversed value before the end of the short-circuit. There was no sparking. In the second case, the brushes being behind the neutral line, the field is weaker and reversal does not take place till later, though the current again reaches its full reversed value before the end of the short-circuit. There was slight sparking in this case.

The second method of determining the current consisted in winding a coil of fine wire alongside, and as near as possible to, one of the armature sections, and with the same number of turns as the armature section. If one end of this fine wire is connected to one end of the section, so that the voltages in the two act in opposition, the volts measured between the other end of the fine wire and the other end of the section will be proportional to the current in the section, neglecting magnetic leakage between the fine wire and the section. This method has the advantage over the last one of allowing the armature to work under quite normal conditions. Fig. 2 shows the results obtained on a dynamo by this method.

Curve I. was taken with a load of 160 amperes at 37 volts and 920 revolutions, and with the brushes in the neutral position. There was slight sparking. Curve II. was taken at 155 amperes, 35 volts and 920 revolutions, with the brushes 9° ahead of the neutral line in the direction of rotation. The brushes covered two segments.

2.—*The Determination of the Voltage Induced in a Section during the Short Circuit.*

For this purpose the fine wire winding described above serves very well. Its two ends are brought out to two slip-rings, and the instantaneous voltage between them is measured by the contact maker as above.

The series of curves shown in figs. 3 and 4 were obtained in this way with various loads and brush positions. All the curves were taken at 930 revolutions. Curves I., II. and III., of fig. 3, were with the brushes 5° ahead of the neutral line, and with 0 amperes and 47 volts, 85 amperes and 40 volts, and 165 amperes and 38 volts respectively. There was no sparking in the first case, very slight sparking in the second, and slight sparking in the last. Curves I., II., III. and IV., of fig. 4, were taken with the brushes 5° behind the neutral line, and with 0 amperes and 49 volts, 50 amperes and 60 volts, 94 amperes and 46 volts, and 144 amperes and 37 volts, respectively. There was no sparking in I or II., and slight sparking in III. and IV. The voltage is marked + when it is in the direction induced in the section by the magnets at no-load, after it leaves the brush. The curves show the gradual fall and change of sign of the induced voltage as the armature reaction increases.

The voltage induced by the rotation is, however, a fairly constant quantity at a given load, and the sudden variation in the centre of the curve can only be due to the self-induction of the section, and the mutual induction of the neighbouring short-circuited sections. This sudden variation corresponds closely in time with the instant at which the current changes suddenly.

3.—*Variations in the Fall of Potential between a Segment and the Brush Touching it.*

In order to investigate this point, one segment of the commutator was connected to a slip ring, and the instantaneous voltage between this ring and the brush was measured by means of the above contact maker. It was experimentally determined that the voltage measured to any part of the brush, either quite close to the contact face or at the top of the brush, was practically the same. Also that at a given instant the voltage from all parts of the segment to the brush was a constant quantity, so that the curve of instantaneous voltage differences between the brush and the various segments touched by it would be made up of a number of horizontal lines at different level, the length of these lines and their height, of course, changing from instant to instant as the segments moved under the brush. The voltage drop across the brush contact being the same all over the segment, it is reasonable to suppose that the current density is also constant all over the segment surface at a given instant, but that it differs from segment to segment. The curves in fig. 5 show the variations of voltage between brush and segment, as the segment passes under the brush. The four curves are for different loads, but all are with the brushes fixed in a position 10° ahead of the neutral line. The zero on the abscissa axis indicates the instant when the segment first makes contact with the brush.

The author hopes to publish further experimental results shortly.

LEGAL.

Record *v.* Brooker & Goss, Ltd.

In the City of London Court, on Friday, before his Honour Judge Rentoul, K.C., an action was brought by Mr. J. W. Record, 10, Albany Road, Leyton, against Brooker & Goss, Ltd, electrical engineers, 50, Broad Street House, E.C., to recover £19 14s. 6d., wages and commission due. There was a counterclaim for £50.

Mr. Owen Thompson, plaintiff's counsel, said the defendants had admitted that some of the money claimed was due. The defendants were seeking to enforce specific performance of a contract for the plaintiff to take 50 shares in the defendant company, because that was his qualification as one of the directors. Before a director could allow his name to appear in the prospectus of a company, he had to sign a consent in writing, agreeing to act and undertaking to take up qualification shares. That consent the plaintiff had signed on February 18th last year, and for some time he attended the directors' meetings during the two months which were allowed by the Act before taking up the qualification shares. The plaintiff was a young electrician, and the defendants were electrical instrument makers and engineers. Messrs. Brooker & Goss had carried on business in their private capacity, but afterwards they turned the business into a company. As a matter of fact, shares were allotted to no one, because the company proved entirely abortive. A prospectus was issued, but there was not sufficient capital applied for to enable the directors to go to allotment or to commence business as a company. In short, the whole thing fizzled out. New directors were appointed, and the plaintiff's office had become vacant. Now, after 18 months, the defendants were attempting to compel the plaintiff to take up 50 £1 qualification shares, although they had never been issued. The plaintiff was employed by Brooker & Goss in 1902, before the business was converted into a company. He had a salary of £2 a week, and 1¼ per cent. bonus on all instruments calibrated in the plaintiff's department. A new agreement was made by which his salary was raised to £2 5s. a week, and from January 1st there was an agreement that it should be raised to £2 10s. a week. That had not been paid. During the last part of the time, while the plaintiff was working for the defendant company he only received a portion of the salary, and some weeks it was as little as 10s. The plaintiff gave notice to leave, but he stayed on, and worked until August 6th. He was now, however, compelled to sue for his wages. The company was incorporated on February 18th, 1903. The first directors were Mr. Brooker, Mr. Goss, Mr. Cruttenden, and the plaintiff. They all signed a consent to act as directors as required by Sec. 2 of the 1900 Act. The plaintiff was nominated as director, and he acted as one of them for a short time. The Act would not allow a director to act for more than two months without taking up his qualification shares. If a director acted longer than two months he was liable to a penalty of £5 a day. During the two months the company struggled unsuccessfully to get to the public and to get the shares taken up. The first prospectus which was issued provided for a capital of £5,000 in £1 shares. The issue proposed was 2,200 shares, of which afterwards Brooker and Goss were to take 1,000 as fully paid up for the purchase money. The prospectus said that the net profits would show a dividend of 8 per cent. per annum on the capital to be issued, and that the directors would not proceed to allotment unless 800 shares were subscribed. The public did not come in, and the whole thing was a frost.

Mr. E. H. Saunders, the defendants' solicitor, said that was quite untrue, for the company was a going concern.

Mr. Thompson said that might be, but the company was unable to pay its debts. The agreement by the plaintiff to purchase qualification shares had become impossible. Not only that, the plaintiff joined the company on the first prospectus, which had been subsequently altered, and the terms on which the shares could now be issued were entirely different. At the end of two months the plaintiff ceased to be a director, and became simply a paid electrician. On May 18th, 1903, the company passed a resolution saying that in consequence of Mr. Brooker, Mr. Goss, Mr. Cruttenden, and the plaintiff, the original directors, having failed to qualify within the proper time, Mr. Brooker, Mr. Goss, and Mr. Edwards were appointed directors of the company. Two of the directors were the same as those who had failed to qualify. The plaintiff was turned out. There had been no allotment of shares, and the plaintiff could not qualify. Therefore the defendants' counterclaim for £50 could not hold water. Under the first prospectus the subscriptions were returned, as the minimum applications were not forthcoming. Then there was another resolution providing that the company should be a private one, but since then the certificate of the Registrar of Joint Stock Companies had been obtained. On the second prospectus, upon which the company did go to allotment, an issue of 5,000 shares instead of 2,200 was provided for. In the first prospectus the vendors took 1,000 shares fully paid as part of the purchase money, whereas in the second prospectus they were to take 3,400 fully-paid, shares, although they were selling exactly the same thing—the business. That, he (the learned counsel) thought, was a marvellous increase.

Mr. Saunders said that had nothing to do with the question at issue.

Mr. Thompson said it was very much to do with the point that the plaintiff could not be made to take shares which he had not subscribed to, or, if he had subscribed to them, it was under a scheme upon a prospectus which had proved entirely abortive. The vendors were eventually going to scoop up £3,400, instead of £1,000, as part of the purchase money. The company was an entirely new one under the second prospectus. The whole assets of the company was the business.

Judge Rentoul said at present he did not see an atom of possibility of making the plaintiff liable on the counterclaim.

Mr. Brooker was called for the defence in support of the counterclaim, and he said the plaintiff was never engaged at £2 10s. a week definitely, but only provisionally. He admitted that the plaintiff's salary was £2 5s. a week; but he said the promise to increase it was only given on condition that the business of the company enabled them to do it. He did not want to discharge the plaintiff, as he was a useful servant. The plaintiff perfectly understood that the company was short of money owing to the present stagnation of trade, and the plaintiff was at liberty to take other employment elsewhere when he felt inclined. For 25 weeks the plaintiff took £2 5s. a week without a murmur.

Mr. Record was called, and he said that there was no provision by which he was only to be paid £2 10s. a week if the company could afford it.

Mr. Saunders argued that, on the law governing the matter, the plaintiff could not recover the sum claimed, and that he was liable for his qualification shares. The plaintiff had acted for more than two months as a director.

Judge Rentoul said if that was the case the plaintiff might be in a position to be sued for penalties, but that could not affect the defendant company's right to compel the plaintiff to take shares which had never been allotted. There were many points in the case which it was utterly impossible for the defendant company to get over, and the whole law library, if it were read to him by Mr. Saunders, could not change the facts.

Mr. Saunders wished to read a case decided in the Court of Appeal, which was in his favour.

Judge Rentoul: The Court of Appeal must have been wrong that time. I must give judgement for the plaintiff on the claim and counterclaim, with costs. The defendant company can appeal, if they like.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"G. V. S." writes:—"We thank you for your answer to our query in your "Legal Query Column" in your issue for the 23rd inst., but we are afraid that perhaps we did not make our original query quite clear.

"Mr. X has on his premises two entirely different and distinct installations, one taking current at 100 volts and the other at 200 volts, and it is as regards the charges for the latter that we wish an answer. Other consumers of current at a pressure of 200 volts are charged at a flat rate of 4½d., but Mr. X is charged for his 200-volt supply at a rate of 6d., with a rebate to 4½d. (which rebate is very rarely earned owing to the system of reckoning) merely because he will not convert his entirely distinct 100-volt installation and make it suitable for a supply at 200 volts.

"This attempt at coercing Mr. X seems to us to be more than mere harsh treatment, in fact, it appears to be distinctly illegal, and we should be glad if you would again find space to give your opinion."

*** The facts above stated certainly disclose a *primâ facie* case of undue preference. The Act of 1882 provides, by Sec. 19, that where a supply of electricity is provided in any part of an area for private purposes, every company or person within that part of the area shall, on application, be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled, under similar circumstances, to a corresponding supply. Sec. 20 provides that there shall be no undue preference, while Sec. 30 to the schedule to the Electric Lighting (Clauses) Act, 1899, provides that undertakers who fail to give a supply are liable to penalties.

The question remains, What course is open to "G. V. S."? Let him refuse to pay more than 4½d. per unit, taking good care to make a legal tender of the amount due on that scale, when payment at the rate of 6d. per unit is demanded by the company. If the company summon "G. V. S." for non-payment, it will then be open to him to show that he is not being treated upon the same terms as other consumers. If the company adopt the drastic remedy provided by Sec. 21 of the Act of 1882, which enables them to cut off the supply until their charges are paid, "G. V. S." could summon the company for failing to give him a supply, when it would be upon them to show that their charges were lawful.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

The Value of Education.

It was gratifying to read "Graduate's" letter in your last issue, for his experience as a lecturer in a London Polytechnic exactly emphasises what has been stated in the few short articles on "Technical Education." Men *are* physically unfit to attend any Polytechnic four or five nights a week, if they work hard all day, and the senate of the London University deserves everything that can be said about it for placing "a premium on this sort of thing by offering a degree" as a reward for attendance. I say outright that the money wasted on evening technical schools has been almost criminally wasted, for there are men with shattered constitutions who will, perhaps, one day bring children into the world. . . . If only one quarter of this money had been spent upon university colleges, and a quarter of it used for founding scholarships for such places, the nation would have saved hundreds of thousands of pounds, and some hundreds, perhaps thousands, of superficially polished so-called engineers. There are some who, like the Mr. Jacks, LL.D., whom my friend quotes, may profit by it; but I say that a system of education should be framed for the ordinary man, and not for the genius.

My sole belief in the London polytechnics is in their use for students who are not in works all day, but who study at home and attend them in the evenings. Their cheaper fees bring them within range of those who could not afford university colleges.

A few days ago I visited Birmingham in order to hear the views of mining engineers upon technical education. I think it was their president who said that the people who wanted educating were the colliery managers. Perhaps even Sir William Arrol—probably a most estimable man, but liable to error—wants educating. Or maybe his D.Sc's. and graduates had never been in a workshop. For it is upon the value of the union of theory and practice that I insist. But I will return, at some later date, to the question of the London polytechnics, meantime I beg to thank "Graduate" for the courteous tone of his letter.

A University Lecturer.

September 23rd, 1904.

A considerable amount of confusion regarding the value of technical education arises from regarding it as *the* factor in engineering. It is only one factor, and its value as a factor depends on circumstances. Professors will readily admit that they are indebted to those who have gone before for the larger part of their knowledge on, say, electricity or steam. But they are slow to perceive that an engineer who goes into a workshop is indebted to the men who have learned engineering before him. To assimilate this knowledge and increase it, he requires experience. But, judging from what has passed during this last year, professors seem to think that an apprentice who goes into a shop for a few years on the sandwich system is qualified for a responsible position. They over-estimate education and under-estimate engineering. A young man in a shop may learn the use of the tools, but may learn little more. Allow that he is a brilliant scholar, he has all his engineering to learn, and this is only acquired slowly, and to an extent depending on his opportunities. As he proceeds, he may be able to apply his knowledge less or more. As a simple matter of fact, influence is a much more important factor than education. An educated lad in his father's shop, with the education of his environment, and able to appreciate the reasonings and instruction of the principal men in the various departments, may learn all the more quickly to fill a master's place through his education and find it of increasing value to him. But if he has no influence, and is above working as a workman, what is he to do? Employers want engineers who are of value to them, and not schoolmasters.

But education of a proper kind is most valuable to every engineer. To a workman it gives a grasp of the principles underlying his work as well as increasing his fitness for responsibility when he has sufficiently learned engineering and an opportunity comes his way.

Night schools are valuable. Though an apprentice is working through the day, his mind is more or less free to, say, solve an equation.

Beechwood.

With reference to the correspondence in your paper *re* "Value of Education," I enclose a circular letter sent to me from what wishes to be called a technical training institute:—

After opening with the very familiar "My dear Sir," it states in the second paragraph, "As you are probably aware there is not another profession that carries such a high rate of pay . . . . as the profession of electrical engineering." Some of us who have "been through the mill" think otherwise.

The next paragraph is evidently meant to be cheering:—"A glance at the 'Situations Vacant Column' of any electrical paper would *prove* to you that there is no difficulty whatever in obtaining a good position in the electrical world." In the first place, a glance at the said column would *prove* nothing; and, in the second place, there is very great difficulty indeed in getting a good position, as there are so many applicants for each.

"By our system we can qualify you in your spare time to enter this profession." I venture to think that there are very few, if any, electrical engineers who have learned their profession in their spare time.

"Under our system you do not require any high education. . . . . All that is necessary is for you to be able to read and write." This is altogether beyond comment if the word "engineer" in the letter is to bear its proper meaning. If the word "engineer" is altered to "wireman" the letter might read better.

"Further, we are presenting, free of charge, to every

student, &c., our 'Complete Reference Library.' There is not *any question* in electrical or mechanical engineering which you cannot solve by reference to these books." Think of that! Evidently this constitutes that month's reading which the Southwark Alderman thought only necessary to be quite "up" in electrical engineering.

This "presented library" savours of the "given away with a pound of tea" idea, and "our system," which can turn a butcher, or farmer, or painter into an electrical engineer in one course of instruction is likely to do more harm than good.

Engineer.

Unfair Competition.

This subject seems to have drifted a little from the original protest against "bribery." Mr. Barham's letter is somewhat trivial. Doubtless what was meant by "Educated Mechanic" and others, was, that they (as do many others out in the cold) possessed a technical trade education. Even as Mr. Barham favours, as per his concluding paragraph.

It is unfortunately true that employers do not sufficiently recognise education as a quality. All that the majority require, is a man that will rush through his work, it seems to matter little how, and consequently put a bigger immediate profit in their pocket. The educated mechanic who, by knowing the principles upon which he is working, can generally turn out a sounder and more efficient job, is not required. It is the principle of keeping a man in his place that retards industrial progress.

There are often better men in the ranks than in the officers' quarters. Were there a few more "Educated Mechanics" instead of the existing plumber or painter, slap-it-in "electricians," who, having once seen, say a house wired, know how it is done, electric lighting, to mention but one branch, might crawl from under its stigma of unreliability; were that stigma removed, how facilitated the task of the canvasser! Mr. Barham has, perhaps, attained a position of some responsibility, but he must not imagine himself a little tin god, and all others mere machines. We are not all unthinking labourers, content as such to remain. Mr. B. seems to have addressed his letter to the latter kindred. It seems to be generally acknowledged that "the electrical trade" cannot get into a much worse state. Now, suppose that instead of grumbling we try and suggest ways of improving things, and again obtain electrical engineering for electricians. It is certainly true that nowadays the major portion of electrical work is carried out by those with other than an electrical knowledge or training.

In fact, in the working grades you will find that to state you are an electrician will not obtain you a berth (to undertake electrical practice) so readily, as stating you are, say, an engine fitter. I might here mention that of a certain Government staff of electricians numbering well over 500, of which I am a unit, exactly 2·8 per cent. are such by trade. And those 2·8 per cent. are by no means the leading hands. Councillors Boyd and Chell, of Southwark (p. 507, Electrical Review, No. 1,400, September 23rd) (however disagreeable the facts are to swallow), are not so far out in their statements. Though not by any means liking their principles, the fact remains that similar principles are very largely practised in the various electrical employments. Electrical work no longer belongs to electricians. There is but one thing to do, viz., retake it. Unfortunately, every electrician's principle seems to be, sink all others, let me swim.

We absolutely must co-operate or go under, but co-operation is almost impossible as long as the terribly excessive influx of new hands continues. To expose the conditions of the trade in the general press is the first and most necessary step, although it goes against our pride, rotten as we know that pride to be.

It is the only step, to disillusion the public regarding this supposed Eldorado, the step to lessen the influx.

Grumbling will not help us. If it comes to doing that, I could give a little list of "things" existing, and about wages and salaries, that would astonish.

Let us have some practical suggestions instead.

B.

Curious Effect on a High-Pressure D.C. Generator.

The effect mentioned by Mr. G. H. P. Morgan is merely the result of the brushes short-circuiting an armature coil, between the two ends of which there is a difference of potential produced by the residual field. The difference of potential may be very slight, but in a short-circuited coil of low resistance will produce excessive current, and, of course, violent sparking.

This is easily illustrated on a large generator by raising all the brushes from the commutator with the exception of one single carbon brush; then run the machine up to speed, and soon the local current through the brush will raise it to a white heat. The effect will be just the same if the brush be held on the commutator by extraneous means entirely unconnected to the brush rocker or any electrical circuit.

If the experimental brush be moved to the "no load" position, no sparking will occur, as found by Mr. Morgan, due, of course, to the fact that the coil short-circuited by the brush is not within the area of the residual field, and there is, therefore, no difference of potential between the ends of the coil or adjacent commutator segments.

J. B. Clarke.

Stourbridge, *September 24th*, 1904.

Faults in Telephone Cables.

The writer thinks it would be of interest to telephone engineers to know more precisely wherein the advantage, and, indeed, the practicability, of the "methods of localising faults in telephone cables," described in your issue of 16th inst., lies; the author states that the tests were designed to meet cases in which the usual methods could not be applied; would not a loop test satisfactorily locate the contact with the lead sheathing represented in fig. 1? Again, the terminals of his instrument must be applied to the lead a few feet apart from one another in order to obtain an appreciable difference of potential; how he proposes making these connections on an erected span of cable is not stated. They could, of course, be made at the poles; this, however, would give but a vague localisation.

F. D. L.

Enamel.—"Sandy" writes:—"I should be glad to hear the name of any enamel suitable for the insides of enclosed engines, one which will fix any foundry sand, and will not be destroyed by either an oil and water bath, or by the oil used for forced lubrication."

THE SOUTH AFRICAN ELECTRICAL INDUSTRY.

In publishing to-day, for the first time, a list of South African electricity works, we place before our readers some interesting data as to the progress of electrical engineering in our colonies. Though great care has been taken in compiling the statistics, we must ask our readers' indulgence should any errors appear, and we extend our thanks to those who have so willingly contributed to the list. We are pleased to see that the South African central station engineers are falling into line with our own engineers in the comparisons of their works. In such a vast continent the towns are few in number, and the list includes all the towns of importance, small though they may be when compared with those in England.

That South Africa is well to the fore from an electrical point of view there can be no doubt, and being as yet largely composed of young colonies, there are wide fields for development. Towns with populations of 1,000 and upwards, which we scarcely heard of before the late war, are now opening works, or have granted concessions for electricity undertakings. With the mushroom-like growth of many of the towns, the list of works will doubtless grow rapidly, especially when there is such a free field, for gas works are confined to four towns, viz., Cape Town, Port Elizabeth, Grahamstown and Johannesburg; and there are no such restrictive regulations in force as there are in England. In

ELECTRICITY SUPPLY STATIONS

Compiled by E. POOLE, A.M.I.E.E., Durban,

Locality	CAPE TOWN (Cape Colony).	KING WILLIAM'S TOWN (Cape Colony).	EAST LONDON (Cape Colony).	DURBAN (Natal).	PIETERMARITZBURG (Natal).
Date of opening	April, 1895	October 23rd, 1903	October, 1899	August, 1897	June 1st, 1898
Owners of works	Municipality	King Electric Light and Cold Storage Co.	Municipality	Municipality	Municipality
Engineer or manager	W. F. Long, A.M.I.E.E.	G. E. Saunders, A.M.I.E.E.	C. W. Moore	J. Roberts, A.I.E.E.	Skidmore Ashby
System	3-wire, 440 volts, direct current	H.T. alternating, 50 cycles single-phase	H.T. alternating, 50 cycles single-phase (light), 550 volts D.C. (trams)	H.T. alternating, 62 cycles single-phase (light), 500 volts, D.C. (trams).	H.T. alternating, 100 cycles single-phase (light), 500 volts D.C. (trams)
Station pressure, volts	440	2,100	2,100	2,500	2,000
No. of consumers	1,259 (February, 1904)	148 (March, 1904)	850 (May, 1904)	2,580 (total)	792
No. of 8-C.P. lamps or equivalent	78,850 (February, 1904)		25,000 (May, 1904)	115,727	24,653
Supply pressure, volts	220 and 440	220	220 and 110	200 and 100 (light), 200 and 100 alt., and 500 D.C. motors	200
No. and type of street lamps	26 arcs, 825 incandescents	200 25-C.P. incandescents	40 Brockie-Pell open type arc (10 in series off 500 v.)	906 incandescents, 230 arcs G.E.C. enclosed, 5 in series off 500 v.	91 arcs alt., Brush, Vienna
No. of motors			20 alt., 6 D.C.	35 alt., 80 D.C.	44 alt.
H.P. in motors	1,397		100 alt., 50 D.C.	117 alt., 899½ D.C.	236 alt.
Units sold last year	1,411,339 (from consumers' average of 1,121)		432,000	1,861,754 (private lighting only)	742,190 (including motors and arc lamps)
Plant capacity in KW.	1,850	190	650 (lighting), 500 (trams)	2,050 (lighting), 1,000 (trams)	1,080 (lighting), 240 (trams)
Boilers	4 Davey-Paxman, 7,000 lbs.; 2 Babcock, 20,000 lbs.	2 Davey-Paxman, 6,000 lbs.	4 Babcock, 220 H.P.	4 Danks, 8,333 lbs.; 4 Babcock, 7,000 lbs.; 3 Hornsby (upright), 14,600 lbs.	14 Hornsby, 2,420 H.P. (total).
Engine	1 Bunsted-Chandler, 200 H.P.; 1 Belliss-Morcom, 450 H.P.; 2 Ferranti, 1,000 H.P.	2 Belliss-Morcom, 75 H.P.	3 300-H.P.; 1 75-H.P. (light); 1 300-H.P.; 3 100-H.P. (trams), all Belliss & Morcom.	4 Yates & Thom, 450 H.P. (trams); 3 Willans, 575 H.P.; 1 Willans, 800 H.P.; 1 Willans, 1,250 H.P. (light)	12 Willans, 2,640 (total)
Price per unit	Sliding scale from 8d. to 1s. 2d.	1s. 3d.	9d. (light), 6d. (motors)	8d. (light), less 15 per cent. above 500 units; 2d. (motors), plus £5 per H.P. per annum	9d. and 6d., light (max. demand system); 2d. to 4d. (motors)
Total cost per unit			9·5d. (light)		6·7d., including cap. charges at 9 per cent.
Remarks:—	Distribution in suburbs by bare overhead L.T. mains. Dynamos:— One 300-KW. Mather-Platt; one 150-KW. Crompton; two 700-KW. English Elec. Mfg. Co.; two 200-H.P. Pelton water wheels in Molento station, driving two D.C. 150-KW. Siemens and Halske dynamos. Tramways owned by company.	Distribution by bare overhead L.T. mains. Supply available from dusk to midnight. Alternators:— Two 50-KW. E.C.C.	Distribution by bare overhead L.T. mains. Costs are high owing to bad position of works. One 200-KW. Belliss set now being erected for traction purposes. (See Tramways Table also.)	Distribution in suburbs by bare overhead L.T. mains. Alternators by E.C.C. and Dick-Kerr, D.C. dynamos by English Elec. Mfg. Co. These returns are up to July 31st, 1904. (See Tramways Table also.)	All distributing and other mains underground Mordey-Victoria alternators. These returns are up to July 31st, 1903. Tramways shortly to be opened.

STATIONS IN PROGRESS.

Locality	PORT ELIZABETH (Cape Colony).	HARRISMITH (O.R.C.).	MIDDLEBURG (Transvaal).	KROONSTAD (O.R.C.).	HEILBRON (O.R.C.).
Owners of works	Municipality	Municipality	War Office	Municipality	Heilbron Electric Supply
System	Direct current, L.T. 3-wire, 440 volts (outers)	H.T. alternating single-phase, 50 cycles	Direct current, 3-wire, 500 v. across outers	Direct current	Direct current, 2-wire
Supply pressure, volts	220 and 440	200	250	230	240
Plant capacity (KW.)	800	185	150	132	
Boilers	3 (type not yet decided)	2 Climax, 3,500 lbs.	3 Ruston-Proctor, 40 H.P. (loco. type)	2 Ruston-Proctor, 40 H.P.	1 Davey-Paxman (loco.), 12 N.H.P. (at present)
Engines	2 steam turbines, each 400-KW.	3 Howden 250 H.P. (total)	3 Willans, 100 H.P.	2 Willans, 100 H.P.	1 Peache-Crompton, 20 H.P. (at present)
Remarks:—	Surface condensing plant. R. Pape, borough elec. eng. The final arrangement of the scheme has been referred to Messrs. Hammond. Street lighting by 54 arc lamps, and 450 Nernst lamps.	To start in September. S. Faithfull, elec. eng., acting for the con. engs. (Messrs. Mordey & Dawbarn). Estimated capital expenditure, £80 per KW. Price for light, 1s. per unit.	Dynamos:— Six E.C.C. 25-KW., 50 Nernst lamps for street lighting. Capital expenditure (estimated) £100 per KW. Supplying current for cantonments only, and about to start.	Due to start shortly. Accumulators.	Distribution by bare overhead mains. Applications received for 1,500 8-C.P. lamps and 20 H.P. in motors. 1s. 3d. per unit (light). Concession held by Messrs. Harris, Lee, & Co., elec. engrs., of Johannesburg. Pumping being considered.

MISCELLANEOUS.

The following towns have also electric lighting plants, but all the information concerning them is not available:—

KIMBERLEY (Cape Colony).—Supplied in bulk from De Beers, at three-phase, 50 cycles; distribution at 120 and 240 volts. Three 540-H.P. Parsons turbines, direct coupled to three-phase 800-KW. alternators.

BULAWAYO (Rhodesia).—Works owned by the Waterworks and Electric Light Co., generating current at 125 cycles, 104 volts, single-phase. At the end of 1903 there were 549 consumers.

CLAREMONT, &c. (Cape Colony).—Works owned by the Cape Peninsula Lighting Co., Ltd. They are now in process of changing to a new system.

POTCHEFSTROOM (O.R.C.).—Works owned by the Potchefstroom Consumers' Electric Light and Power Co. Three-wire distribution, 235-240 volts, D.C., at 1s. per unit. Dürr boiler, 25 N.H.P.; Marshall engine, 25 N.H.P.; two Bergman dynamos, 25-KW. The Town Council has just decided to purchase this plant.

DELAGOA BAY.—J. Askew, engineer.

DUNDEE AND GREYTOWN (Natal) also have small plants.

The following towns have electric lighting schemes under consideration, or concessions have been granted:—

TRANSVAAL.—Barberton, Krugersdorp, Klerksdorp, Standerton, Boxburg, Heidelburg, Pietersburg, Middleburg (town).

CAPE COLONY.—Kalk Bay, Umtata, Kokstad, Craddock, Paarl, Queenstown, Aliwal North, Wellington.

ORANGE RIVER COLONY.—Bethlehem, Winburg.

NATAL.—Vryheid.

BRITISH EAST AFRICA.—Nairobi.

RHODESIA.—Salisbury.

BECHUANALAND.—Mafeking.

The following towns have tramway schemes under consideration: Bulawayo, Kimberley, Bloemfontein, Johannesburg, and Durban suburbs.

OF SOUTH AFRICA.

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LADYSMITH (Natal).	NEWCASTLE (Natal).	PRETORIA (Transvaal).	JOHANNESBURG (Transvaal).	BRAKPAN (Transvaal).	GERMISTON (Transvaal).	BLOEMFONTEIN (O.R.C.).
August, 1903	July, 1903	June, 1902	1892	1897	March, 1898	November, 1900
Municipality	Newcastle Elec. Light Syndicate	Pretoria Lighting Co.	Municipality	Rand Central Electric Works, Ltd.	General Electric Power Co., Ltd.	Municipality
J. S. White	J. Butler	T. C. W. Dodd, A.M.I.E.E.	R. H. Covernton (acting manager)	H. Spengel (manager)	A. W. K. Peirce	H.F. Peet, A.M.I.C.E., city engineer
3-wire, 400 volts, direct current	3-wire, 440 volts, direct current	3-wire direct current	H.T. alternating, 60 cycles, single-phase (town), 50 cycles 3-phase (suburbs)	H.T. alternating, three-phase, 50 cycles	H.T. alternating, three-phase, 60 cycles	H.T. alternating, three-phase, 50 cycles
440	440	500	2,000	12,000	3,300	2,000
100		1,000 (1904)	1,231	26, supplied in bulk	387, December, 1903 (Germiston)	290
	1,600 (approx.), various C.P.	32,000 (1904)			9,166	12,200
200	220	250	100 (town), 120 (suburbs)	120 (lighting), 240 and 500 (motors); 2,100 for Johannesburg	115 (lighting), 200 (motors), Germiston	110 and 200
4 arcs, J. & P. "Ark," 160 32-C.P. incandescents	32 and 16 C.P. incandescents	80 arcs, New Century type	62 series arcs, 996 incandescents		A few arcs of various makes	15 arcs, A.E.G.
			8	60	13 (December, 1903), Germiston	None
			89	1,900	92 (December, 1903), Germiston	None
		600,000	1,577,000 average per annum, from Johannesburg and Brakpan	8,192,680 (December, 1903)	253,932 (Germiston), 4,576,524 (total)	20,340 (May only)
100	120	800	800	2,800	1,500	500
3 Robey (semi-loco.), 2,475 lbs.	2 Multitubular, 100 H.P.	8 Marshall-Heine	12 tubular	8 Steinmüller, 500 H.P. (multitubular)	2 Babcock, 212 H.P.; 4 Stirling, 300 H.P.	4 Babcock, 800 H.P. (total)
2 Willans, 100 H.P.	2 Macintosh & Seymour, 100 H.P.	5 Chandler	15	4 Hartman, 1,000 H.P.	3 Allis, 750 H.P.; 3 Bumsted-Chandler, 45 H.P.	3 Belliss - Morcom, 790 H.P. (total)
8d. to 1s.	1s.	11d. (light), 4d. (motors)	1s. 2d. (light), 8d. (motors)	6d. first 2 hours, 1d. thereafter	9d. (light), 4d. (motors), Germiston	1s.
			6·68d.	1·5d. (works cost)		9½d.
First year's running not completed. Bare overhead L.T. mains, with middle wire earthed.	Concession held by the above company. Bare overhead L.T. mains. Dynamos:— Two 60-KW. G.E.C. 4-pole, compound.	Day supply just started. The Town Council has just decided to purchase this company's plant as a going concern.	These figures are from the cons. engineers' report of December 13th, 1902; and owing to the new scheme in hand, including tramways, they cannot be taken for comparison with other works. There is also a gas works owned by the Corporation. The Brakpan works supplies the three-phase portion of the town in bulk. The Robinson Deep Mine are also supplying a portion of the town.	Alternators:— Four 3-phase 700 KW., by Siemens and Halske, 22 miles of H.T. bare overhead lines to Johannesburg, supplying the mines *en route*.	Alternators:— Three 3-phase 500-KW., one 500-KW., driven by a Curtis steam turbine; four 300-H.P. Stirling boilers are now being added. This Co.'s main business is supplying the mines in bulk, and the returns qualified by "Germiston" do not include the mines.	There is also a 35-KW. steam alternator working in conjunction with the destructor.

TRAMWAY SYSTEMS.

Locality	LOURENCO MARQUES (Delagoa Bay).	DURBAN (Natal).	PETERMARITZBURG (Natal).	EAST LONDON (Cape Colony).	CAMPS BAY (Cape Colony).	PORT ELIZABETH.	CAPE TOWN.
Date of opening	February 17th, 1904	May 1st, 1902.	September, 1904	January, 1900	1902	June 16th, 1897	August 6th, 1896
Owners of system.	Electric Tramway Co.	Municipality	Municipality	Municipality	Camps Bay Tramway Co., Ltd.	Cape Electric Tramway Co.	Cape Electric Tramway Co.
Engineer or manager.	E. F. Foote	H. N. Thomas, A.M.I.C.E.	P. Finlayson	C. W. Moore	L. Noakes	J. A. Barkley (general manager)	J. E. Lloyd (general manager)
System	Trolley, 550 volts, D.C.	Trolley, 500 volts, D.C.	Trolley, 500 volts, D.C.	Trolley, 550 volts, D.C.	Trolley (side arm), 550 volts, D.C.	Trolley, 500—550 volts, D.C.	Trolley, 550 volts, D.C.
Particulars of cars.	8 double-deck cars, Trucks by the McGuire Manufacturing Co. (four-wheel).	43 double-deck cars, four-wheel Brill trucks, B.T.H. equipment, 2 sprinklers, and 3 stone trucks.	12 double-deck cars, 6 with four-wheel Brush trucks, Westinghouse equipment; 6 with max. traction Brush trucks, and B.T.H. equipment. 1 sprinkler.	15 double-deck cars, 3 four-wheel Brill trucks, E.C.C. equipment; 6 four-wheel Peckham trucks, G.E.C. equipment; 6 four-wheel Brill trucks, Dick-Kerr equipment.	Single-deck bogie cars, four-motor Westinghouse equipment.	27 cars, chiefly double-deck, four-wheel, B.T.H. equipment, also 4 trailers, and 1 sprinkler.	65 cars, double-deck, 15 single-deck, B.T.H. and Dick-Kerr equipments.
Particulars of track.	7·76 miles (single, 3ft. 3⅜in. gauge)	4·88 miles (single), 7·5 miles (double), 4 ft. 8½ in. gauge, 87 lbs. girder rails.	6 miles (single), 1 mile (double), 4 miles girder 94 lbs.; 3 miles Vignoles, 65 lbs.; 4 ft. 8½ in. gauge.	3½ miles (single), girder 76 lbs., 4 ft. 8½ in. gauge	9 miles (single), girder rails, 90 lbs., 4 ft. 8½ in. gauge.	3·04 miles (single), 4·16 miles (double), 4 ft. 8½ in. gauge, girder rails.	13·145 miles (single), 5·125 miles (double), 3·34 miles (sidings), 4 ft. 8½ in. gauge, girder rails.
Particulars of power plant.	Two Belliss and Morcom engines, two 200-KW. Lancashire dynamos, Babcock & Wilcox boilers.	See Lighting Table	See Lighting Table	See Lighting Table	2 water-tube boilers, 12,000 lbs. evaporation; 2 Yates and Thom engines, 720 H.P.; 2 Dick-Kerr dynamos, 400 KW.	4 Babcock & Wilcox boilers, 1,218 sq. ft. heating surface. 4 McIntosh and Seymour engines, 150 H.P. 4 G.E.C. dynamos, 100-KW.	1 Yates & Thom 900 H.P.; 1 McIntosh and Seymour 900 H.P.; 3 Philadelphia Engine Co. 300 H.P. engines; 4 Heine 300 H.P.; 4 Babcock & Wilcox 235 H.P. boilers; 1 500-KW. Dick-Kerr; 1 525-KW. G.E.C.; 3 200-KW. dynamos, Westinghouse.
Financial data		1s. 8·11d. traffic receipts per car-mile.		1s. 6d. running cost per car-mile.			1·59d. works cost per unit.
Remarks:—				Two miles of track in hand, and a further mile is under consideration.	Grades, 1 in 12, rising to 800 ft. above sea level. This company has leased its system to the Cape Electric Tramways Co.	730,000 units generated last year.	801,000 units (average) generated per month.

the matter of low-pressure distribution, it will be seen that very free use is made of overhead mains, a condition of things which enables the smallest towns to adopt an electricity supply, and the larger towns to supply their suburbs at a minimum of expenditure, whilst the towns proper in the latter cases are generally supplied by underground cables.

The supply of electricity to a portion of Johannesburg is carried by overhead mains for 22 miles from Brakpan, in this case at 12,000 volts; and in Durban some 60 miles of low-pressure pole line are erected, supplying the residential portion, which extends over a large area.

Though Durban, the third largest town in South Africa, has the largest combined works at present, we have no doubt that Johannesburg will take that position when the large combined traction and lighting scheme now in hand is completed. We are pleased to note that the contracts in connection therewith, amounting to over £340,000, have been given to British firms.

The industries of South Africa, apart from mining, are of a very limited nature, and until the labour question has been settled, and more confidence is shown, new industries are not likely to go ahead, and consequently electrical projects are withheld. The Bloemfontein Industrial Commission's report is awaited with interest, and that Commission will probably recommend the Governments to encourage the minor industries by granting bonuses, and affording substantial support to such industries as will utilise the material of the country. They will also recommend the employment of experts to instruct the Colonials in the manner of producing finished goods from the raw material. The recent work done by Prof. Hele-Shaw, in view of establishing technical schools all over the country, will no doubt have good results, and he has been very ably supported by the various Governments in the matter.

Turning to electrical work other than town lighting, the harbour authorities at the various ports are in keen competition with each other to secure the handling of goods for the up-country districts, and large developments are either in hand or contemplated. Delagoa Bay is a keen competitor with Durban, and has taken the lead in the matter of electric cranes and Temperley transporters, as recently reported in our columns. The question of electric *v.* hydraulic cranes is still a subject of much discussion with the Natal Harbour Board, and the fact of their proposing to send their harbour engineer Home, is ample proof of their readiness to be "up to date." Large harbour works are now in hand at the head of the bay, and a Bill has recently been passed by the House of Assembly authorising the expenditure of a large sum of money for an electric power station on the Bluff in place of the present one. At East London the Harbour Board have large extensions in hand, including electric cranes, whilst at Cape Town the Harbour Department have a large station for the generation of electricity in connection with the docks.

The railways of South Africa are also not behind-hand in the matter of electricity, most of the main line trains being so lighted, and the majority of the works along the line have generating stations in connection therewith. The electrification of the railway is as yet a suggestion; the first section to be so equipped is most likely the new line recently laid down, running the length of the Witwatersrand Reef. Further north to the Zambesi there are immense possibilities for electricity works, which we are too modest to forecast, but railway electrification seems highly probable, and the report of the engineers who are now there preparing data as to the available power will be read with much interest.

This district is, perhaps, the only one we can look to where water-power may be made use of on anything like a large scale, for the rivers of South Africa generally are very unreliable, owing to the lengthy seasons of drought; some which are at times a roaring torrent, being at other times a mere trickle. A paper is in course of preparation on the available power of the rivers of South Africa, to be read next year before the British Association on their visit to the Cape.

In Natal there are but two water-power transmission plants, one at the Kearnsey Tea Estates, and the other at the Nels Rust Dairy Farm. The Howick Falls, near Pietermaritzburg, have often been referred to by engineers, but in the "dry season" the amount of water is of too limited a nature.

In British Central Africa, the Civil authorities at Zomba have a small water-power plant for the lighting of the officials' bungalows, and a concession has lately been obtained for the lighting of Nairobi, in British East Africa, by water power. In the northern parts of the Transvaal, the Transvaal Gold Mining Estate at Lydenburg has a three-phase water-power plant, and in the Baberton district, Pigs Peak, Moodies, and the Sheba Mines are similarly equipped, in the latter case the plant being two-phase. In the Cape Colony a water-power plant has recently been put down for the Cape Orchard Co., at Hex River.

With the development of the mining industry of the Rand and Rhodesia, we may expect large demands for machinery, the present tendency being to centralise the electric generating stations in the place of many small and scattered plants. Good examples of such are at Brakpan and the Rand Victoria. Electric haulage has not yet been put into use on anything like a large scale, but on the deep level mines we are certain to find a field for development. The "Village Deep" are just equipping a light tramway, operated by electricity, in one of their levels. The applications to pumping and coal-cutting are becoming very popular, and manufacturers will do well to follow up these matters. The air drill still holds sway, in spite of the great inefficiency of transmission from the compressors. The telegraph and telephone industry is very active just now, many new lines being in hand throughout the territories recently annexed, and the telephone systems of the older towns are being remodelled on the latest ideas. Trunk lines are being run which will put Johannesburg in connection with the coast towns and others *en route*.

The present must not be thought by any means an opportune time for those seeking appointments to throw in their lot with South Africa, as there are thousands of men of various trades out of employment, the competition amongst electrical engineers being very keen. As the trade of the country improves, and it can only be expected to improve gradually, there should be good openings for really practical men, such as central station engineers, cable jointers, armature winders, linemen, wiremen, &c., though in the two latter classes the country seems well stocked. It must, however, be borne in mind that the wage is not so high as it looks, when the very high cost of living is taken into consideration, and one should well consider the matter before giving up a Home appointment in favour of one in South Africa.

English manufacturers are at a loss to understand why they have not a better footing in the South African market, but if the principals established South African offices or agencies they would realise the keenness of American and Continental competition; their being directly represented would facilitate business far better than being content to bid only for that which passes through the London houses. In the case of their having agents appointed, they should more fully support them by supplying the very fullest information and keeping them "up to date" in new inventions. "Spot quotations" are the order of the day, more particularly on the Rand. Between the few leading manufacturers directly represented there at present, and the local merchants, some of whom import low grade material from the cheapest markets, there seems to be an unfairness, for invariably the buyers for the various mines accept the lowest tender irrespective of quality, and it is to the mine owners that we must look for a remedy, such as requiring the consulting engineer of the group to insist upon the quality being considered. Often the indents sent home are not clearly worded, thus causing delay, and, generally, the average British manufacturer will not guarantee an adequate sum for his agent's expenses; the result is that the agent devotes himself to the more liberal houses, while the American agents, on the other hand, lead one to believe they are the heads of their firms in the matter of spending money.

With regard to standardising machinery and having a plentiful supply of spares, English manufacturers would do well to follow American practice. The local conditions of the country should be more closely studied, and greater attention should be given to packing, testing and special requirements. The freight rates to South Africa are also a

severe handicap to England, and the report of the combined Governments of South Africa, who are now considering the matter of adjustments, will be awaited with great interest. It is well known that the American rate is 15s. per ton cheaper than the British, and this alone is sufficient to show why England has not a larger share of the South African trade. It is hoped that the Shipping Conference will grant the ordinary merchant the same reduction as they have already ceded to some of the South African Governments and Mining Groups, as, collectively speaking, the ordinary merchants represent their largest customers.

The present Customs Preference of 2½ per cent. upon Home goods is quite insignificant when dealing with such expensive articles as machinery.

BUSINESS NOTES.

Electrical Wares Exported.

Week ending September 29th, 1903.	
Alexandria	Value £77
Amsterdam	65
Auckland	20
Bombay	93
Buenos Ayres	267
Calcutta	1,269
„ Teleg. mat.	990
Cape Town	301
„ Teleg. mat.	1,036
Christchurch	43
Demerara	75
Durban	2,274
„ Teleg. mat.	625
East London	2,219
Fremantle	2,310
Hong Kong	292
Kobe. Teleg. cable	298
Lisbon	481
Lyttelton	50
„ Elec. machinery	490
Madras	48
Malaga	43
Malta	85
Melbourne	251
Paris	278
Perth	143
Port Elizabeth	70
Rotterdam. Teleg. wire	11
St. Thomas	64
„ Submarine cable	1,812
Shanghai	219
Singapore	133
Stockholm. Teleg. wire	48
Sydney	506
„ Teleg. mat.	120
Timaru	370
Valparaiso	16
Wellington	225
„ Teleg. mat.	666
Yokohama	184
„ Teleg. mat.	119
Total	£18,696

Week ending September 27th, 1904.	
Amsterdam	Value £90
Bombay	311
„ Teleg. mat.	179
Boulogne	25
Bremen	15
Buenos Ayres	199
Calcutta	1,636
„ Elec. machinery	583
„ Teleg. mat.	50
Cape Town	41
Colombo. Elec. machinery	41
Delagoa Bay	295
Demerara. Teleg. mat.	168
Durban	534
„ Teleg. mat.	142
East London	477
Flushing	62
Fremantle	1,276
Gibraltar	544
Gothenburg	30
Hamburg. Teleg. mat.	980
Hobart	15
Hong Kong	76
Lyttelton	29
Malta. Teleg. instruments	111
Melbourne. Elec. machinery	99
„ 152 cwt. teleg. wire	
Montreal	169
Nagasaki	34
Odessa	156
Otago	28
Perth. Elec. cable	888
„ Elec. instruments	96
Shanghai	306
Singapore	302
Stockholm. Submarine cable	1,450
Sydney	1,007
„ Elec. cable	1,234
„ Elec. machinery	170
Wanganui	54
Wellington	1,356
„ Teleg. mat.	633
Yokohama	592
Total	£16,483

Foreign Goods Transhipped.

Durban. Elec. mat.	Value £132

Durban. Elec. appar.	Value £16
„ Telephones	479
Singapore. Elec. apparatus	48
Sydney. Elec. lamps	110
„ Elec. mat.	545
Total	£1,198

Drop Forgings.—Among processes for manufacture of the parts of his machines, the American electrical engineer employs drop forging to a considerably larger extent than is common in this country. This is, no doubt, due partly to the extreme standardisation that obtains in the States, which enables the articles to be made in such quantities that the cost of the expensive dies ceases to be felt; and, partly, to the great accuracy of forgings made by the American method, in which the dies (instead of being cut away in the ordinary fashion) have large contact faces, ensuring a positive thickness of forging irrespective of the amount of "flash." A few years ago Messrs. Thomas Bolton & Sons installed at their Oakamoor works, a complete American plant, under an American foreman, and have found an increasing demand, especially for commutator bars, terminals, and finger tips, in copper and bronze; and, latterly, turbine blades, forged in hard aluminium alloy. The company have recently added an equipment of forging presses, which is busily engaged in the production of rail bonds for electric traction, which have previously been all imported; so that traction engineers may now not only have the satisfaction of using home-made goods, but have the advantage of getting anything special in length or design attended to promptly, without the loss of time that would necessarily be involved in referring such matters abroad.

Brimsdown.—In our recent article on the Brimsdown power station, we omitted to mention that the patent glazing system of Messrs. Sam Deards, Ltd., was used throughout for the glass roofing.

Russia.—The balance-sheet of the Compagnie Centrale d'Electricité de Moscow for the last financial year shows a loss of 424,545 roubles.

Curtis Turbines for Japan. — It was recently announced that a large contract for Curtis steam turbines for supplying power to a Japan street railway had been placed with the General Electric Co., of America. Information has just come to hand that the Nagoya Electric Light Co.'s plant is to be extended, and, for this purpose, the British Thomson-Houston Co., the holders of the patent rights of the Curtis turbine for Great Britain and Ireland, inform us that a contract has been placed through the Japanese house of Mitsui & Co., for a 500-kw. Curtis turbine set.

Electricity in Collieries.—Orders have recently been placed with Monté-Callow & Co., for three 40-h.p., four 75-h.p., two 100-h.p., and three 250-h.p. "Perfecta" polyphase controllers for haulage gear for a South Wales colliery.

Electric Meters.—The British Westinghouse Co. ask us to state that they are determined to uphold their patent rights in connection with alternating current meters, and have recently commenced an action against the Ferranti Co. for infringement. The case will be heard probably early in the new year.

Exhibition.—An International Exhibition is to be held at Brussels from October 1st to 23rd, at the Salon des Arts and Metiers. Letters respecting same should be addressed to the Administration Générale, 93, Rue du Midi, 93, Brussels.

Private Telephones.—Among recent work carried out by the National Telephone Co.'s Contract Department is an installation of 24 30-line Berliner intercommunication lever instruments for Messrs. Clement, Talbot's new motor manufacturing works at North Kensington, by which any one department can communicate with another; a special intercommunication magneto ringing installation for Messrs. Speyer Bros., 7, Lothbury, by means of which any point can have exchange line facilities; also, for Messrs. Harrod's Stores, Brompton, a metaphone installation in their Town Ledger Department, by means of which the chief in command is enabled to be in instant communication with any one of the 18 ledger clerks.

Strike Settled.—The dispute at Messrs. Graham, Morton & Co.'s works, to which we referred in our last issue, has been settled. The union officials refused to recognise the unauthorised action of the men in absenting themselves from work, and Messrs. Graham, Morton & Co. undertook to take back as many men as they required. Some minor grievances as to checking and the question of overtime will now be settled by the firm having joined the Employers' Federation. The attitude of the firm is this: they refuse to be coerced by the union into employing only union men, and maintain their right to perfect freedom to employ whom they please, and will have no interference in the management of their business.

Educational Notices.—*Queen's College, Belfast.*—We have received a copy of the regulations for the academic year 1904-5, with the subjects of lectures and examinations. Prof. M. F. Fitzgerald is at the head of the School of Engineering, and examinations for scholarships in this subject will be held next month.

City and Guilds of London Institute.—The opening ceremony of the Central Technical College, Exhibition Road, S.W., takes place on Tuesday afternoon next. The recent changes and extensions in the electrical engineering department render the laboratories and lecture rooms beyond question the best laid out and equipped in London, while the course of study, which extends over three years (under Prof. W. E. Ayrton, F.R.S., and his chief assistant, Mr. T. Mather, Wh. Sch., F.R.S.), is designed to give the student a thorough practical and theoretical training in his profession.

The day classes at the Institute's Finsbury Technical College, Leonard Street, E.C., will commence on the same day as at the Central, while the evening classes begin on the previous day. The courses are shorter than at the Central, being laid out on a less ambitious scale, extending over two years only. Prof. Silvanus P. Thompson, F.R.S., D.Sc., &c., is the head of the electrical engineering department, which is well equipped with experimental apparatus, &c.

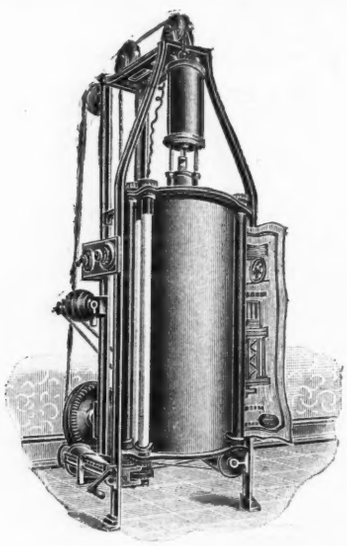
Glasgow and West of Scotland Technical College.—We have received the Calendar for Session 1904-5, of which the frontispiece is a view of the magnificent building in course of erection for the College; these will be the largest of the kind in Great Britain, and will, when fully equipped, have cost £250,000. A portion of them will be occupied during the present session, which opened on Tuesday last. The Electrical Engineering Department is conducted by Prof. M. Maclean, D.Sc., &c., and his assistants.

Imports of Foreign Electrical Goods and Apparatus.—Large quantities of foreign electrical goods and apparatus continue to reach this country, the imports during August last being valued at £67,766, bringing up the total for the first eight months of the year to £502,265, as contrasted with only £499,807 in the corresponding eight months of 1903.

Trade Announcements.—We understand that Mr. Rudolph Grunhut, of 34, Gracechurch Street, E.C., has been appointed sole agent for this country and the Colonies for the Regina arc lamp (400 hours).

Messrs. E. Goossens, Pope & Co. notify that business developments have necessitated their removal to larger premises. The new address, to which they removed on September 24th, is 5, Arthur Street, New Oxford Street, W.

An Automatic Blue-Printing Machine.—We illustrate herewith an automatic blue-printing machine, or photo-copier, for making copies from tracings by electric light. It is designed to overcome the difficulty experienced in making very long prints, such as are required for railway plans and profiles, designs for bridges, ships, and other constructional work. Such prints are usually made in sections and joined together, but the result is generally unsatisfactory, owing to the diversity of tints in the several sections, and the varying shrinkage of the paper in drying, which makes it impossible to obtain continuity of the lines. By the present machine, prints may be made in a continuous piece up to any desired length, while the feeding of the paper and the tracing, the traversing of the lamp across them, and the securing of the necessary contact between them, are effected automatically. The rate at which the work is passed through the machine is adjustable



through a wide range, to adapt it to tracings of different density, and to slow or rapid printing papers, and the whole is driven by a small electric motor. While primarily designed for the production of long prints, the machine is found to be equally efficient in printing short lengths, which are fed in one after another, so that, while one is being printed, another is being taken out or put in. Thus a boy can attend to several machines, or, where only one is used, he can print and develop at the same time. The machine is being put on the market by Mr. Leonard Shaw, of 39, Victoria Street, London, S.W.

Fire.—A fire occurred early on Monday morning last, at the works of Messrs. Hodgson, Wright & Wood, electrical engineers, Green Mount, Hanson Lane. The conflagration was caused by the overheating of a gas stove, which had been left alight since the previous Saturday for the purpose of drying dynamos. The damage was very slight indeed.

Bankruptcy Proceedings.—At the London Bankruptcy Court on September 20th, the public examination was held before Mr. Registrar Brougham of George Wm. Warner and Arthur Philip Boughen, lately trading as Warner & Co., electricians, &c., at 12, Holbein Place, Sloane Square, S.W. The debtors failed in July with total liabilities £3,939 15s. 7d., of which £2,210 12s. 7d. is unsecured, and assets valued at £60 10s. 11d. Questioned by Mr. Egerton S. Grey, Official Receiver, the debtor Warner stated that he started business in 1897 as an electrical engineer in partnership with another person at 12, Holbein Place, under the style of Warner and Shirley. Their joint capital amounted to £70, of which witness introduced £50. That partnership was dissolved in May, 1901, Mr. Shirley retiring and receiving £20 for his interest in the business. Witness was next joined by Mr. Boughen, but no fresh capital was introduced, and the business suffered from want of funds. In June, 1903, they started speculative building operations at Norbury and Southall, but abandoned them in March, 1904, upon an execution being levied by a creditor on the plant and material which were subsequently sold by the Sheriff's officers. The freeholders then entered into possession of the unfinished properties. They continued to trade at 12, Holbein Place until April 6th, when they closed the business, and on May 13th they returned to the owners electrical fittings, &c., held on sale or return, to the value of £30. Witness attributed the firm's failure and insolvency to want of capital, to inability to realise their properties and to pressure by creditors. On the application of Mr. A. C. Bourner, the trustee, the sitting was adjourned to November 1st to enable the debtors to file a cash account showing how the loss on the trading returned in the deficiency account at £1,809 4s. 8d. was arrived at.

A receiving order has been made on a creditor's petition against Henry Coles, electrical engineer, of 10, York Street, Swansea.

Dissolutions and Liquidations.—At the meetings of the Bath Electric Manufacturing Co., Ltd., held at Bath on August 22nd and September 6th, it was resolved to wind up voluntarily for the purposes of amalgamation with H. V. Kramer & Co., of Bath, and Messrs. Drewett & Hood, of Bristol. Mr. A. C. Comley, of Albion Chambers, Bristol, is liquidator.

Messrs. Barnaby & Co., Ltd., electrical engineers, of Great College Street, Rotherham, are winding up voluntarily, with Mr. H. J. Allen, of St. Peter's Close, Sheffield, as liquidator.

Messrs. J. Marks and Hugh Clarkson (Marks & Clarkson, electricians and electrical engineers, Gothic Arcade, Snow Hill, Birmingham), have dissolved partnership. Debts, &c., will be attended to by J. Marks, who will continue the business.

Messrs. Procter & Cottrill, Ltd., electrical engineers, Cromford Court, Market Street, Manchester, are winding up voluntarily, with Mr. H. G. Cantrell, 6, Elm Grove, Weaste, near Manchester, as liquidator.

Messrs. W. H. Bradbury and James Marsden (Bradbury, Marsden and Co., brassfounders and electric light fittings manufacturers, Woodcock Street, Birmingham), have dissolved partnership. Mr. Bradbury will attend to debts.

Creditors of the Electrical Machinery Developments Co., Ltd., must send particulars of their debts to the liquidator, Mr. F. N. Lowther, 151, Cannon Street, E.C., by November 19th.

A meeting of the Marquand Accumulator Co., Ltd., is to be held at 12, Mount Stuart Square, Cardiff, on October 31st, to hear an account of the winding up from Mr. R. Leyshon, the liquidator.

A first and final dividend of 4d. in the £ in *re* the Warrington and District Electric Light and Power Co., Ltd., is payable on October 3rd at 4, Egypt Street, Warrington.

Book Notices.—*A Technological and Scientific Dictionary.* Part V. Edited by G. F. Goodchild and C. F. Tweney. London: Geo. Newnes, Ltd. 1s. net.

The Indicator Handbook. Part II.: the Indicator Diagram. By C. N. Pickworth, Wh.Sch. Second edition. Manchester: Emmott and Co. 1904. Price 3s. net.—The authoritative position which the author of this volume has attained, with regard to all that pertains to indicators, renders it superfluous to praise his work. We need only mention that Part II. of the handbook under consideration deals with the analysis of indicator diagrams and the calculations based thereon, and covers not only steam and gas engine diagrams, but also diagrams from air compressors, pumps, ammonia compression machines, &c. In the new edition a description of the Mathot explosion and pressure recorder has been embodied, on account of its increasing use in testing internal combustion "motors." The handbook is indispensable to engineers who have to do with the running or testing of heat engines, &c.

"The Diseases of Electric Machinery: Their Symptoms, Causes, and Remedy." By C. Kinzbrunner, A.M.I.E.E. London: Harper and Bros. 1s. 6d. net.

"International Telegraph Convention and Service Regulations." 1903 Revision (London). In the original French text, with English translation. By C. E. J. Twisaday and G. R. Neilson. "Preliminary Conference at Berlin on Wireless Telegraphy" (August, 1903). Translation of the Procés-Verbaux and Protocole Final. By G. R. Neilson. London: The *Electrician* Printing and Publishing Co., Ltd. 6s. net and 8s. 6d. net each, respectively.

"The Story of Wireless Telegraphy." By Alfred T. Story. London: George Newnes, Ltd. 1s.

"The Physical Review: American Physical Society." Vol. xix., No. 3. September, 1904. London and New York: Macmillan and Co., Ltd.

"L'Ozone et ses Applications Industrielles." By H. de la Coux. Paris: Ch. Dunod. 15 fr. and 16.50 fr.

For Sale.—Messrs. Percy Huddleston & Co. will, on October 5th (next Wednesday), offer a quantity of electrical plant, steam engines, tools, &c., for sale by auction at Hammersmith. See particulars given among our advertisements to-day.

Trouble at Trafford Park.—According to an article in the *Manchester Daily Dispatch*, there has lately been trouble among the employés at the British Westinghouse Co.'s works at Trafford Park. The trouble is said to have arisen in the machine shop, and about a thousand hands were expected to strike toward the end of last week, as a protest against a threatened reduction of wages. In an interview with the general manager, it was explained to a representative of our contemporary that slackness of work had made it necessary that the wages should be reduced to the level of the district rate. The company would rather do that than close down.

Catalogues and Lists.—A list of "Valor" letter-filing cabinets has been received from the VALOR CO., LTD., of Birmingham.

A small catalogue of several lines of steam engines has been issued by MESSRS. E. READER & SONS, LTD., of 5, New London Street, E.C., and Nottingham.

The latest sheet issued by MESSRS. ERNEST F. MOY, LTD., relates to their enclosed resistances with perforated steel covers.

The METALLIC JOINTING AND PACKING CO., of Ardrossan, are making template stands, work stands, workman's tool and iron stands, also service bolt racks. Circulars dealing with each of these separately have just been published.

The HUNTER ELECTRIC CANDLE LAMP CO., LTD., of 77, Newman Street, Oxford Street, W., have sent us a list of their "Huntalite" electric candle lamps and holders, which are claimed to be a perfect imitation of lighted wax candles. Various styles of fittings with these lamps can be seen at the company's show rooms.

The ELECTRICAL CO., LTD., of Charing Cross Road, W.C., has just brought out a new pamphlet in which its continuous current motors and starters are described, also the E.G. dynamos and

motors. Instructions are given for the maintenance and supervision of continuous current machinery, directions for the use of liquid starters, rules for installation of motors and switchgear, also fuse and wiring tables.

A catalogue of arc lamp carbons made by MESSRS. HENCKEL AND JORDAN, of Baden, near Vienna, has been sent to us by Mr. M. Seeck, of 6, Henrietta Street, W.C., their sole agent over here.

Circular No. 106 issued by MESSRS. SIEMENS BROS. & CO., LTD., gives full illustrated particulars of their patent uninterchangeable safety fuses (E P 1) for currents up to 10 amperes at 250 volts and 6 amperes at 500 volts.

Mr. WM. PATTERSON, of Walkergate, Newcastle-on-Tyne, has published a new circular relating to his "Matchless" self-lubricating dynamo-brushes.

A new price list of alternating current polyphase motors has reached us from MESSRS. JOHNSON & PHILLIPS, of Old Charlton. Notes briefly describing the construction of the motors are followed by some full particulars of their installation and working. Tables of powers, speeds, efficiencies, &c., of motors with short-circuited armatures, and with armatures wound for the insertion of a starting resistance, are printed, and some views of the motors applied to driving are included. An abridged list of the motors for mining work has also been issued.

We have received from MESSRS. J. & H. MCLAREN, of Leeds, two beautifully illustrated catalogues relating to their steam engines. The one on "Traction Engines and Their Uses," by Mr. John McLaren, commences with a description of the firm's works, accompanied with photographic views thereof, and then proceeds to describe thrashing, heavy haulage, and military engines, also carriages and wagons, and steam ploughing machinery, winding up with some notes on the pioneering work done in the Colonies by the firm. The other catalogue is devoted exclusively to engines for electric generating stations, and is, therefore, the one of more direct interest to our readers. Some of the leading types of McLaren engines and other plant which have been installed in English electricity works are shown by means of faultless half-tone illustrations. At South Shields station all of the plant (3,250 I.H.P.) has been entirely engined by Messrs. McLaren. The firm's open-type, medium-speed, triple-expansion engine is described at some length, indicator diagrams and governing test tables being reprinted. A high-speed enclosed triple-expansion engine of 600 I.H.P., and one of 3,000 I.H.P., are shown, also a set of independent surface condensing plant. Power station engineers will be able to obtain a copy of this brochure on application to the Midland Engine Works, Leeds.

Circulars of cast and wrought-iron electric light fittings for mine, ship, yard, and car-shed use, also single and double-pole main switches, have been sent to us by MESSRS. J. H. HUMPHREYS AND SONS, of Horsedge Electric Works, Oldham.

LIGHTING AND POWER NOTES.

Australia.—At the Jumbunna coal mine in Gippsland, a 40-H.P. motor and four 20-H.P. motors have been installed for driving winches to convey compressed air for working the pneumatic machinery used in driving the cutters. The larger unit is coupled to two winches, and the smaller ones to one each. The mine is to be lit by electricity.

Caerphilly.—The U.D.C. has appointed Mr. Preece, of London, to carry out the E.L. scheme.

Calcutta.—The Port Commissioners have recently been calling for tenders for an electric-power installation at the Kidderpore Docks. Tenders had to be in by September 15th.

Cardiff.—At a recent meeting of the Electric Lighting Committee, Mr. Ellis, the electrical engineer, reported that up to date, £11,318 had been borrowed from the rates, and £9,499 paid back, leaving a balance due to the rates of £1,818. Out of the estimated surplus profit for the current year it was proposed to relieve the rates by £3,000, so that at the end of the year the department would have actually relieved the rates by £1,200; and also to increase the reserve fund by £2,232, bringing it up to £4,413. This was in addition to paying the loan charges. In reply to Councillor Chappell, Mr. Ellis said there was no practical need for a depreciation fund. The reserve fund would meet any emergency that might arise.

Cleethorpes.—The Council has decided to take over the tramways power station of the Grimsby Tramways Co., the price to be £17,000. The estimated cost of additional plant, &c., for giving an electric supply to the district is £20,000.

Coventry.—The Corporation has received the sanction of the L.G.B. to the borrowing of £30,388 for the extension of the electricity works, to be repaid in 26 years.

Croydon.—The T.C. has reduced the price of energy on the maximum demand system from 7d. and 2d. to 7d. and 1½d.

Dartford.—The E.L. accounts for the year ended March 31st last show a deficiency of £1,619 chargeable on the general district rate. The total expenditure during the year was £2,818, leaving on the actual working a gross profit balance of £15 before meeting financial charges.

East Ham.—The L.G.B. is to hold an inquiry into an application by the U.D.C. to borrow £10,320 for electric lighting purposes.

Edinburgh.—The result of the last year's working of the Corporation E.L. undertaking, ended May 15th, 1904, is given below, together with the figures for the preceding 12 months:—

	1904.	1903.
Revenue, private lighting and power	£105,800	£91,567
,, public lighting	10,101	11,505
,, meter rents and sundries	278	293
	£116,179	£103,365
Total working cost, including public lighting..	£43,521	£41,240
Interest	£20,638	£20,161
Sinking fund	£28,023	£27,432
Profit balance on year's working	£23,997	£14,532
Inclusive average price obtained per unit ..	2·629	2·757
Total works cost per unit	·985	1·1
Total number of units sold..	10,604,865	8,995,808
Total capital expended	£845,337	£800,710

Fochabers, N.B.—In consequence of the Duke of Richmond installing plant to supply electricity to Gordon Castle, the inhabitants, on the recommendation of the Bellie P.C., decided to petition for a supply to the township. It is now intimated that if 950 lamps are required, his Grace will supply energy at 4s. per 16 C.P. per annum, plus 1s. per lamp for interest on cost of installing.

Foots Cray.—The financial statement recently presented to the U.D.C., included £300 received in respect of the sale of the E.L. prov. order.

Germany.—The municipal authorities of Marburg have decided on the establishment of an electric generating station in the town.

Hawick.—At the adjourned Valuation Appeal Court of the burgh, Mr. Scott, the assessor, intimated, in reference to the request of the Urban Electric Supply Co., that the valuation should be reduced from £1,316 to £421, that he had been in communication with the company's agent, and it had been mutually agreed to fix the annual value at £800. This arrangement will remain in force for three years, by which time it is expected that assessors and electric companies throughout Scotland will have arrived at a uniform basis of valuation.

Hull.—The North-Eastern Railway Co. has applied to the Corporation for a supply of energy to light Paragon Station, the number of lamps being 222 16-C.P., and also for power for signal working.

India.—According to the *Advocate of India*, experiments are to be made in Simla as to employing electric motors to replace coolie labour for propelling jinrickshaws.

Leeds.—A stack of coal stored at the electricity works, Whitehall Road, was discovered to be on fire on the night of 20th inst. The outbreak was due to spontaneous combustion, the coal having been stored in a wet condition, and the firemen had great difficulty in dealing with it. The store consisted of about 1,000 tons, and was housed over the boilers.

Leicester.—The electric lighting accounts for the working of the department for the half-year ended June 30th last, show a profit, after deducting interest on capital account, of £5,792; from this amount, £3 221 has been allocated to sinking fund, leaving a net profit of £2,571.

London.—STEPNEY.—The L.C.C. are to be asked to advance £20,000 for the eastern extension of the electricity undertaking, and £3,960 for electric meters.

BATTERSEA.—The experimental public electric lighting by the B.C. in Lombard Road and Vicarage Road is to be made permanent, but ½-ampere Nernst lamps are to be substituted for the other lamps; also four additional lamps are to be fixed. The public lighting by electricity of the Shaftesbury and Beaufoy Estates is to be completed at an estimated cost of £447.

MARYLEBONE.—Part of the properties required for the generating station, it is stated, have been purchased by the B.C., but there still remain some outstanding questions as to the title to some of the property forming part of the undertaking, in consequence of which the B. of T. has not yet fixed the date of commencement. It has been decided to press the Board on this question.

A fire occurred at the Metropolitan Electric Supply Co.'s Tower Street, W.C., sub-station at 10.15 a.m. on the 24th inst., through the short-circuiting of copper strip laid in compound, the strip leading up to the D.C. switchboard. Large quantities of gas poured off the compound owing to the heat, and fired, destroying the whole of the D.C. Ferranti switchboard and some other boards. The copper strip bent in all directions owing to the heat, and short-circuited the L.T. bus-bars. The fire was extinguished at 10.45 a.m., and the supply was restored by 12·50 noon. The station itself is of practically fireproof construction, and, but for the firing of the compound, the damage would have been slight.

Mexbro'.—At a recent meeting of the U.D.C., a petition asking for a reduction of price to private consumers was under consideration, and was adjourned for the Electricity Committee's consideration. The balance-sheet of the electricity undertaking shows a gross profit of £901, as against £380 for the 10 months'

working in 1903. After meeting financial charges, a deficit of £340 remains, as compared with £179 in the previous period. The latter amount, it should be stated, was the balance of an original deficit of £720, which was partly covered by damages received from contractors.

Ormskirk.—The Board of Guardians has decided to install E.L. plant at the Workhouse, at an estimated cost of £3,100. A company had offered a supply of energy at 4d. per unit for lighting and 1½d. for power.

Pembroke (Co. Dublin).—The L.G.B. has refused to extend the period allowed for repayment of the Council's E.L. loan of £25,000 from 27 to 37 years. The clerk stated that he had received a letter from Mr. Hammond, stating that the Board has sanctioned an extension in the case of the Dublin Corporation. A deputation was appointed to wait on the L.G.B. in regard to the matter.

Southend-on-Sea.—The T.C. has decided to apply to the L.G.B. for a loan of £56,000 for extensions of plant and buildings at the electricity works. The additional plant would comprise three steam dynamos, four boilers, an economiser, auxiliary machinery, mains, and services.

Stourbridge.—The U.D.C. has approved an agreement with the Midland Electric Corporation for Power Distribution for a supply of electricity to the district.

Sydney, N.S.W.—At a recent Council meeting, it was stated that the plant at present installed had a normal capacity of 1,080 KW. Applications had been received for 282 KW. of motors, 37 KW. arc lamps, 169 KW. incandescent lamps, 210 KW. street lighting, and 180 KW. for the Town Hall lighting, making a total of 878 KW. applied for.

Tewkesbury.—The T.C. has decided to apply for a prov. order for E.L.

Walthamstow.—The electrical engineer reported on 23rd inst. that the total works costs for the 12 months ended March last amounted to £4,663; interest, £3,003; sinking fund, £2,505. Satisfactory progress is being made with the erection of the new tramway plant.

West Ham.—The borough treasurer has submitted a statement as follows, showing the financial results of the electricity undertaking:—Year ending March, 1899 (three months' supply), deficiency, £1,124; year ending March, 1900, profit, £196; year ending March, 1901, deficiency, £2,492; year ending March, 1902, profit, £1,125; year ending March, 1903, profit, £1,624; year ending March, 1904, deficiency, £3,788; net deficiency to March, 1904, £4,459. He estimated that on the 12 months to March, 1905, there would be a probable further deficiency of £3,400. This would have to be met by the general rates, but he estimated that the tramway revenue for the year would be so good that out of it, £8,000 would be available for the relief of the rates. The whole of the last issue of £500,000 Corporation stock has been subscribed, and £97,889 1s. 6d. is available for the electric light undertaking.

Weymouth.—The Corporation E.L. undertaking was inaugurated on 26th inst., a banquet being afterwards held at the Hotel Burdon.

Willesden.—The U.D.C. on Tuesday received a statement of receipts and expenditure of the E.L. undertaking for the first complete year of working. The expenditure included £8,363, the principal items of which were: repayments of loan raised for sub-stations and mains, £2,787; generation of electricity to February 8th, 1904, £1,607; purchase of electricity in bulk from February 6th, 1904, to date, £1,478; other expenses, including public lamps, £2,462. The receipts were £8,549, the principal items being: private consumers, £5,362; public lighting, £2,821; rent of meters, £200. After allowing for bad debts, there remains a balance on the year's working of £177.

The Committee, after consideration, has decided to adhere to the maximum demand system of charging, consumers' average price working out at 3·74d. per unit. An alternative scale is to be allowed for power supply, the charge to be on the "two-rate meter" system of 1½d. and 4d. per unit. A discount of 5 per cent. is also to be in future allowed off all consumers' accounts which are promptly settled. Mains extensions, at a cost of £782, have been sanctioned.

Wolstanton and Burslem.—The Board of Guardians has engaged Mr. Ashton Bremner, A.M.I.E.E., to prepare an E.L. scheme for the Workhouse, and to carry it out at 5 per cent. upon the total cost.

Zeehan (Tasmania.)—The Town Board has entered into a further agreement with the Electric Lighting Co. for lighting the streets, the price being 3s. 4d. per week per 32-C.P. lamp.

TRAMWAY AND RAILWAY NOTES.

Belfast.—Very strong efforts are being made to secure the contract for the reconstruction of the system to some local firm in order to prevent the importation of labour; this is in view of the great depression in all business and trades about the city.

Birmingham.—The Tramways Committee on Tuesday inspected Mr. Baker's arrangement for covered tops, and gave instructions for a car so fitted to be put on the road for trials. They also received the petition in opposition to the Harborne Road route, and decided to inquire into the matter before proceeding further. It is stated in this petition that the result of a canvass of the district showed an opposition majority of about 2 to 1.

A start has now been made with the foundations of the new generating station for tramway power supply.

Bury.—The last section of the Corporation tramways—the line to Tottington—was inspected last Saturday by Major Pringle, for the Board of Trade, and is now open for traffic. There is only a 2-mile break in the through tramway communication between Bury and Liverpool.

Continental Notes.—It is stated that the Ganz and Finzi systems of alternating-current traction will shortly be the subject of competitive trials on the Valtellina branch of the Adriatic Railway. One of the electric motor-cars of the Bologne-Modena branch of the railway will be transformed by replacing the experimental storage battery equipment by a single-phase alternating-current equipment designed by Finzi. Four single-phase geared motors of 100 H.P. each will form the equipment, wound for 200/400 volts. Step-down transformers will reduce the line voltage from 3,000. Only one phase of the Valtellina line will be used by the Finzi car. The maximum speed of the car will be 72 kilometres per hour, and trains of 100 tons will be hauled. As is well known, the storage battery cars of the Milan-Monza line have been withdrawn from service, after trials extending over four years.

On the Valtellina line are also to be run three new locomotives with three-phase equipment, recently delivered by the Ganz Co. The extension of this plant indicates that the line has achieved a certain success, and it is believed that it has given better results than its builders had hoped for.

A convention is about to be signed between France and Spain relative to the construction of three light railway lines across the Pyrenees, uniting the two countries. The difficulties of execution of these plans are well known, and the ten years given for the construction of the lines is not excessive, bearing in mind that the Pyrenees rank with the Alps in the numerous natural obstructions to the realisation of the scheme.

A Brown-Boveri-Parsons turbo-alternator of 300 KW. 3,000 volts has been ordered for a new elevator at Marly (France). This firm has succeeded in placing several important orders recently for its turbine groups in French territory. Two Curtis turbines will shortly make an appearance at Nice, each of 800 KW. output, 10,000 volts.

In view of the very unsatisfactory state of the majority of the street traction companies in Paris and district, especially of the omnibus companies and the tramways, a commission has been appointed by the Paris Municipality and the Seine General Council, consisting of the chief engineer entrusted with the supervision of traction affairs and a numerous staff, which will proceed on an extended visit to the chief cities of Europe, and thence to the United States, where the conditions affecting tramway interests will be investigated. The concession for a number of omnibus and tramway lines, especially those owned by the Compagnie Générale des Omnibus, will expire in less than five years hence, but the reconsideration of the whole situation, made necessary by the lapsing of the concessions, has been hastened by the opening of the first two lines of the Paris Metropolitan Railway, and the line No. 3, to be partly inaugurated next month.

With the same length of line in service as in 1903, the Metropolitan Railway Co. has carried, over its 24 kilometres in service, up to September 20th, 1904, over 80,000,000 passengers, with 14,000,000 fr. receipts. This is an increase over the same period of 1903 of some 6,550,000 passengers and 1,200,000 fr. receipts. With the opening of line 3, it is expected that these figures will show a very great increase.

Perth (W.A.).—The *Australian Mining Standard* says that the Perth Electric Tramways, Ltd., has commenced the construction of two new loops and other track additions. The material has been ordered in London. The company will introduce fresh power plant, including a 300-H.P. engine and generator, and a boiler of 250 H.P. To further increase the capacity of the generating machinery, a complete condensing plant for 1,000 H.P. is to be installed. It is proposed to erect a new stack 150 ft. high, with an internal diameter 7 ft., a cooling tower 70 ft. high, to double the size of the car-barn, and to carry out numerous minor improvements to meet the increased demands of the service.

Stockport.—The negotiations between the Stockport Corporation and the Stockport and Hazel Grove Tramways Co. for the purchase of the company's undertaking were re-opened a week or two ago, and it is now announced that terms have been agreed upon. The company has accepted an offer of £24,000. The Stockport Council has ratified the agreement; and so soon as the company's shareholders have signified their assent, steps will be taken to electrify the 4 or 5 miles of tramway line between Stockport and Hazel Grove at a cost of something like £70,000. It will be one of the most important routes in the Stockport district.

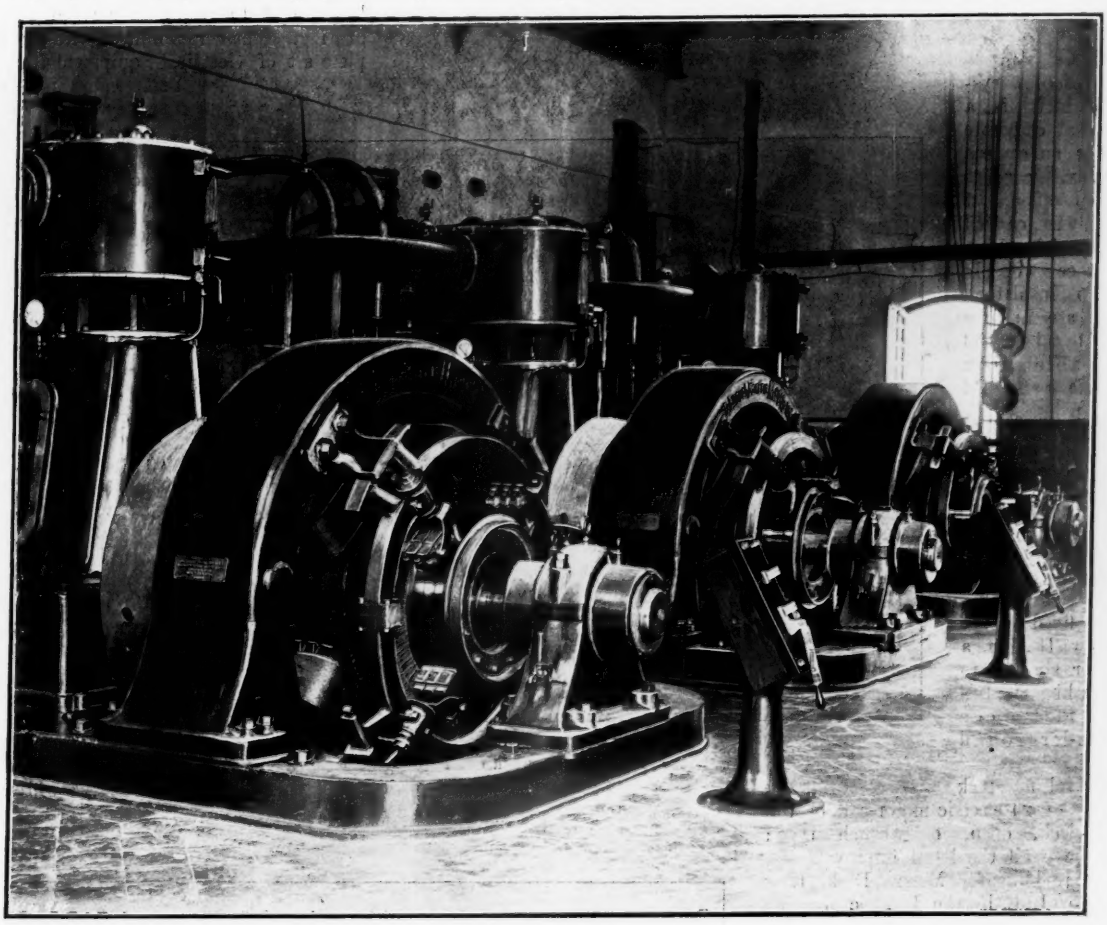
(*Continued on page* 543.)

ELECTRIC TRACTION IN MANDALAY.

A few weeks ago a short announcement was published in the Electrical Review relating to the opening of an electric tramway system in Mandalay by the Lieutenant-Governor of Burma, Sir Hugh Barnes, K.C.S.I., K.C.V.O. The system has now been in successful operation for the last two months, and in view of the fact that Mandalay is the first city in Burma to adopt the very latest mode of transit, in the shape of electric cars in place of horse traction, a brief description of the undertaking will no doubt be of interest.

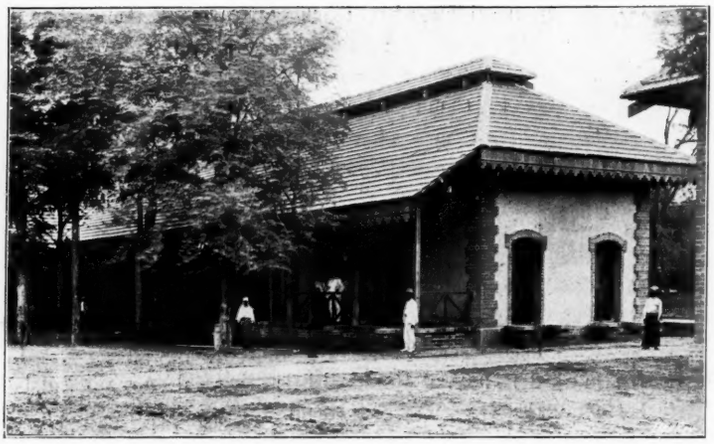
The Mandalay Electric Co. was floated in London in October, 1902, with a capital of £200,000. Actual work was commenced in December of the same year by the contractors, Messrs. Dick, Kerr & Co., Ltd., and within the short space of a year and a half the first car was moved by electrical power on June 17th, 1904. The centre of the tramway system has been wisely placed at the new Zegyo Bazaar, on which the municipality is spending a large sum of money; this promises to be, when finished, the largest bazaar of its kind in the East, and a position that will become a centre of attraction to the Burmese from all parts of the city. From the Zegyo Bazaar the tramways radiate in three branches. One leads to the shore, where the Irawaddy Flotilla Co.'s steamers embark their passengers, and so will cater for the travelling public. The second runs to the Arakan Pagoda, and will serve the suburbs which cluster round that famous shrine. The third leads to the Court House, where the legal business of the city and district is transacted daily; a certain number of citizens will always desire to resort to this quarter, and will doubtless use the tramways for that purpose.

The tramways have a route length of seven miles, double track throughout, and therefore equal, exclusive of cross-over roads, approximately 14 miles of single track. The rails are in accordance with standard tramway practice, 6 in. deep, with a 1¼ in. groove; they are laid to a gauge of 3 ft. 6 in., in 45-ft. lengths, with a proportion of shorter lengths to allow for piecing-in and closures. The rails are double spiked to hardwood sleepers, which are spaced at 2 ft. 9 in. centres, the whole being laid on a ballasted bed; the road surface is made up with macadam in the ordinary way. The joints are of the plain type, and are secured with six-holed fish-plates, and double-bonded with two 0000 B. & S. Neptune pin bonds, the usual cross and inter-track bonds being provided.



View of the Generating Plant.

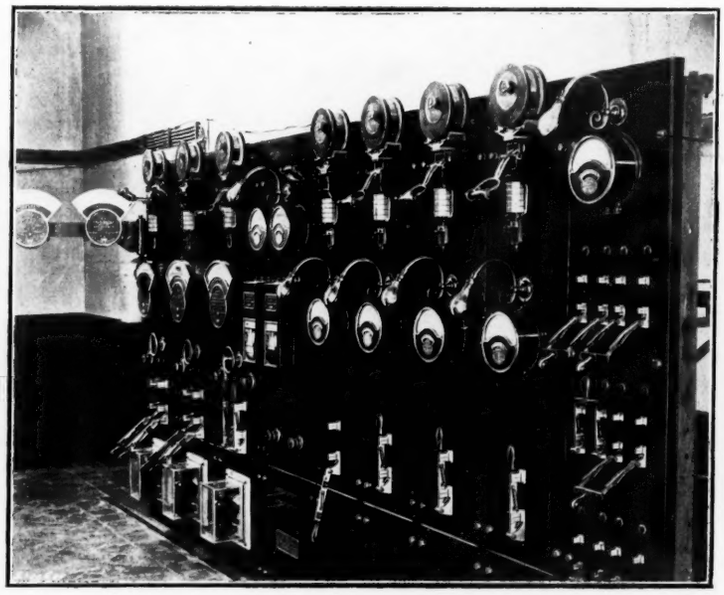
The overhead equipment is constructed on the span-wire system, a double line of trolley wire being used throughout. The standards are made of solid-drawn, weldless steel tubes, and have an overall length of 28 ft.; they are set 6 ft. deep below the upper surface of the rails, the excavation being then entirely filled with concrete. The trolley wires consist of hard-drawn copper ·364 in. in diameter, with a breaking strain of 23 tons per square inch. Section insulators are provided, so that each half-mile of trolley wire can be controlled separately if required. Lightning arresters of the Garton Daniel type have been provided at every half-mile.



Tramway Offices.

The feeder system, which is a somewhat elaborate one for an eastern tramway, consists of solid soft-drawn copper wire, carried on special high resistance toggle clamp insulators, which are in turn bolted to substantial malleable iron brackets attached to the poles.

At several points along the route of the tramways these feeders are tapped by insulated cables, which are connected to the main feeder switches in switch pillars fixed on the side-walk, in a manner similar to that which is followed in the case of underground feeders.

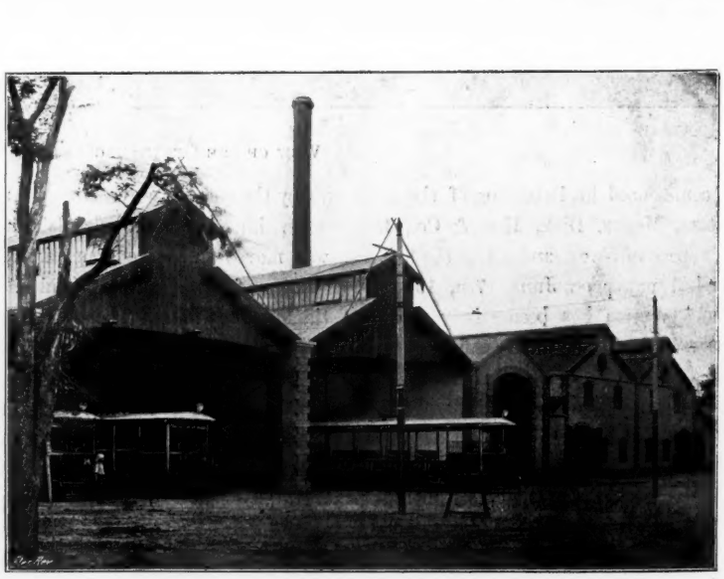


Main Switchboard.

The rolling stock consists of 24 electric motor-cars of the single-deck, open, cross-bench type; these have all the latest improvements, and were built for Messrs. Dick, Kerr and Co., Ltd., by the Electric Railway and Tramway Carriage Works, Ltd., Preston. Special care has been taken in designing the cars to ensure the interchangeability of all the important parts entering into the construction of the rolling stock; the car bodies are 35 ft. 4½ in. in length, and about 6 ft. wide, and are designed to provide seating accommodation for 48 passengers. The floor frames are built of well-seasoned teak, in combination with steel sections of such members and sizes as to ensure maximum strength and minimum weight. Openings are arranged in the frame over the motors to afford convenient access to the commutator and brushes, and to all bearings requiring frequent inspection and oiling. The platform floor frames are formed of teak timbers extending under the main floor frame as far as possible without interfering with the clearance of the trucks, and project out from each end sill 3 ft. to provide room for the brake shaft and controllers. Teak end bars are secured to the outside ends of these timbers, forming sills to which the platform dashes and the entrance steps are secured. To prevent the car from sagging, a substantial truss is provided, supported in the centre by two wrought-iron standards. Storm curtains are provided for each side entrance of the car, sliding in grooves between the posts. Each car is provided with two circuits of 100-volt incandescent lamps, with change-over switches for putting one or the other headlight in circuit.

The trucks upon which the cars are mounted are of the Brush Co.'s single type, suitably built to support the car bodies and to receive the motors and gearing. The cars are fitted with a complete set of electrical equipments, each set consisting of two of the well-known Dick, Kerr standard 25 B. traction motors, capable of delivering approximately 28 H.P., the temperature of the various parts not exceeding 75° C. after running at full-load for one hour. The controllers supplied with the electrical equipments are of the same firm's standard D. B. I. form "C" type, specially arranged with resistances for emergency braking, operated by the driving handle.

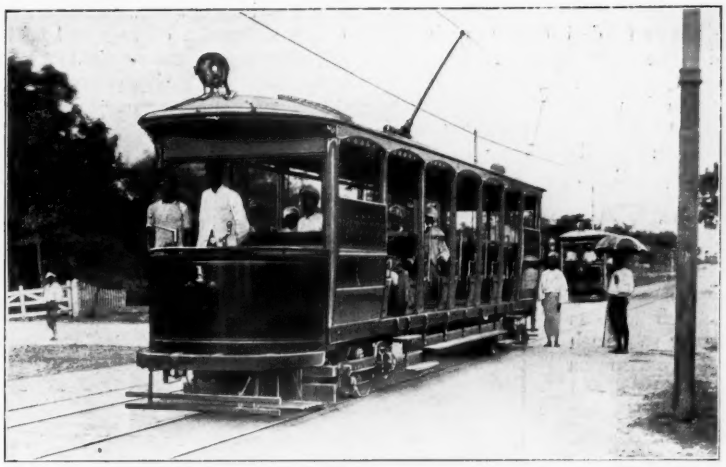
The power house has been erected on the company's site in 78th Street, together with the necessary offices,



Car-shed and Power Station.

car-shed and repair shops. The steam plant consists of three Babcock and Wilcox water-tube boilers, built for a working pressure of 160 lbs. per sq. in., and each provided with a steam superheater and all the usual accessories; a water storage tank with a capacity of 20,000 gallons of water; a fuel economiser; and two double-acting single-cylinder feed pumps, each capable of delivering 2,000 gals. of water per hour.

The engines, which are three in number, are of the well-known "Belliss" compound two-crank type, mounted on bed-plates extended to take the direct-coupled generators; each engine is fitted with a heavy fly-wheel and steam separator, and is capable of giving a normal output of 300 B.H.P. when running at 400 revolutions per minute, non-condensing, with steam at a pressure of 155 lbs. per sq. in. at the stop valve.



Car at Court House Terminus.

Lieut.-Governor's Car en route to the Shore Terminus.

The electrical plant consists of three direct-current compound-wound generators, the output of each generator being 200 KW. when running at 400 revolutions per minute, and they are designed to give an overload of 20 per cent. for 2½ hours, with a moderate rise of temperature; the current is generated at a voltage of 500—550. The generators are in every respect in accordance with the standard practice of Messrs. Dick, Kerr & Co., Ltd., the magnet frames being of cast-iron, and the pole-pieces of laminated steel cast into the magnet frame; the commutation is sparkless at all loads, and the field windings are so arranged as to give a 10 per cent. rise in the E.M.F. from no-load to full-load.

The switchboard was built by Messrs. Dick, Kerr & Co., Ltd., and consists of nine black enamelled slate panels, 1½ in. thick, each supported, independently, on an iron frame. The board consists of three generator panels, four feeder panels, one station lighting, and one B.O.T. panel.

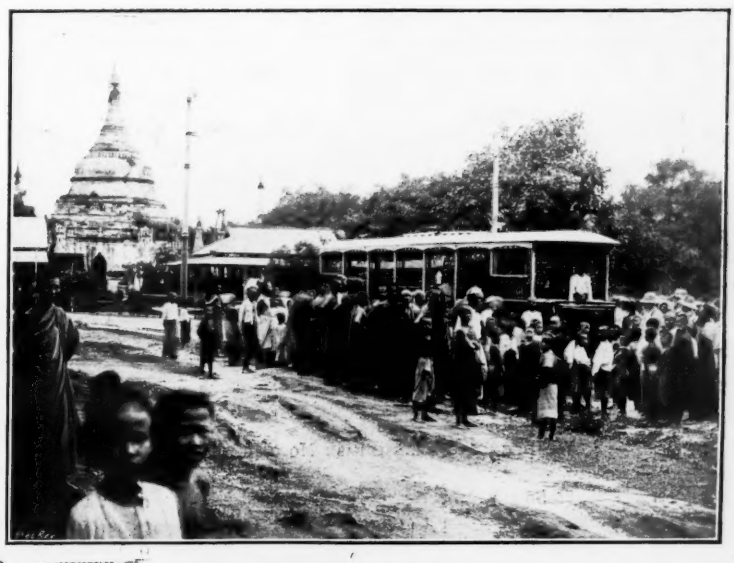
Each generator panel is provided with two single-pole switches; one equalising switch; one shunt field rheostat; one field switch with resistance and pilot lamp; one main ammeter; and an automatic circuit-breaker with magnetic blow-out.

Each feeder panel is provided with one main single-pole switch; one automatic circuit-breaker; and one ammeter.

The testing panel has mounted on it all the necessary instruments and switches for measuring and recording the leakage taking place; also a recording voltmeter for recording the difference in potential between the terminus ends of the rails and the negative bus-bar. The station circuit panel is equipped with all the necessary switches and fuses, together with ammeters required for the station lighting and motor circuits.

One of Messrs. Higginbottom & Mannock's 10-ton travelling cranes for a span of 38½ ft., with a lift of 20 ft., has been erected in the engine room; the various motions are worked by chains from the engine room floor.

The contractors for the whole of the work and plant were the well-known firm of Messrs. Dick, Kerr & Co., Ltd., represented in Mandalay by Mr. T. Williamson; the sub-contractors were Messrs. Nahapiet & Martin, of Rangoon. The consulting engineers for the work were Messrs. Kincaid, Waller, Manville & Dawson, of Westminster, who prepared the detailed plans and specifications, and were represented in Mandalay by Mr. E. Sellon. The local work was carried out under the able superintendence of Mr. Griffin and Mr. A. C. Morgan.



Pyagyi Terminus and Arakan Pagoda.

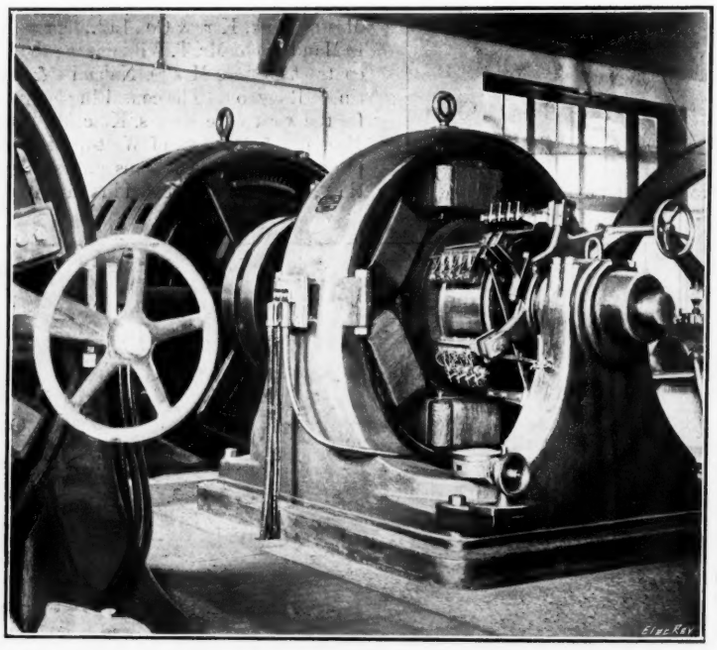
THE ELECTRICAL PLANT AT BATIGNOLLES RAILWAY STATION.

The Compagnie des Chemins de fer de l'Ouest recently put into operation at the Batignolles railway station, near Paris, an electric sub-station intended for supplying power and light to the urban and suburban goods stations and the Clichy-Levallois passenger and goods station, the engine depôt, the Batignolles and the Levallois workshops.

The greater part of the electric material of this station, transforming 5,000 volts alternating current into 500 volts direct current, has been supplied by the Société Anonyme Westinghouse. It includes two motor-generator sets, each consisting of a three-phase asynchronous motor of 850 H.P. at 5,000 volts and 25 cycles, without any special starting device, that drives a 600-KW. dynamo at 500 volts D.C., running at the speed of 295 r.p.m. One of these sets has already been installed, while the other will be taken into use shortly. There is also one set consisting of a 440-H.P. three-phase asynchronous motor at 5,000 volts and 25 periods, which drives a 300-KW. 500-volt generator, running at 365 r.p.m.; and a Tudor accumulator battery of 1,000 ampere-hours has been added, with a view to securing continuity of service during any disturbance that might occur in the high pressure line.

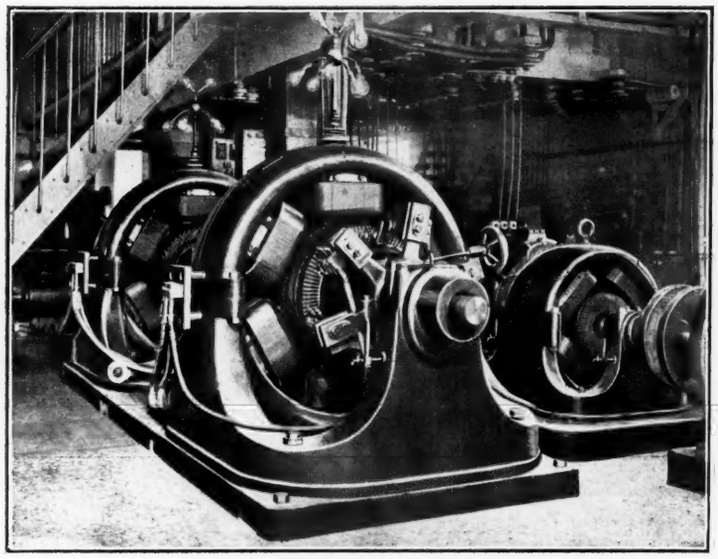
The distribution of energy is effected on the three-wire system, the working of the station being so regulated as to give at the places of utilisation 220 volts on each side of the neutral wire, which is connected to earth.

The station is fitted with a 100-KW. balancing set running at a speed of 550 r.p.m., consisting of two rigidly-coupled generators, excited from the opposite sides of the system.



WESTINGHOUSE THREE-PHASE MOTOR-GENERATOR.

For starting the two 600 and 300-KW. sets, there have been provided two auxiliary sets, each consisting of a three-phase 40-H.P. asynchronous motor at 220 volts, which is started up on 110 volts, supplied from the terminals of a single-phase oil transformer, having two connections on the secondary windings, so as to enable either 220 or 110 alternating volts to be obtained at will. This motor drives a 30-KW. generator at 500 volts, supplying either separately, or in parallel with the dynamo of the second set, the current required for the starting of the big units,



100-KW. BALANCER AND 15-KW. BOOSTER.

and, if necessary, for their separate excitation. In order to maintain the voltage of the principal machines constant, irrespective of the load of the system, the Westinghouse Co. has provided a regulating shunt, allowing of any desired proportion of the total current being made to pass through the compound winding of the exciting dynamo.

The charging of the battery is effected by means of the 600 and 300 KW. generators. For charging the battery end cells there have, however, been installed two booster sets consisting each of an asynchronous motor, fed from two single-phase Westinghouse oil transformers (5,000 : 100 volts) and coupled to a Westinghouse booster dynamo generating 15 KW. at 110 volts and 750 r.p.m.

By means of a special device, either of the two battery ends may be charged from one of these booster groups.

The Société Anonyme Westinghouse has supplied also all the switchboards necessary for controlling the above machines, as follows:—A high pressure main switchboard, including a high pressure feeder panel, on which are arranged two oil switches, one watt-hour meter, two ammeters, one voltmeter, an automatic main circuit-breaker, and oil switch, controlling the 850 and 440 H.P. asynchronous motors; a high pressure secondary switchboard, bearing four automatic oil circuit-breakers of the new Westinghouse type, controlling the four single-phase transformer groups, feeding the two exciting sets and the booster sets; a low pressure main switchboard, including three panels on which all starting devices are arranged, two panels for controlling the 600-KW. generators, one panel for controlling the 300-KW. generator, one for operating the balancing machines, and a reserve panel; and a switchboard for controlling the feeders, divided into five panels, corresponding to the five localities to be supplied with current, controlling instruments, both for the power and lighting circuits, being installed on each of these.

TRAMWAY AND RAILWAY NOTES.

(*Continued from page* 538.)

Bury and Rochdale.—Payment of the purchase money in respect of the Bury, Rochdale and Oldham Steam Tramways Co.'s undertaking has been allocated to the different local authorities. The total amount awarded by the arbitrator was £162,675. It is payable as follows:—By Rochdale and Wardle, £70,390; Littleborough, £7,034; Royton, £15,544; Heywood, £20,437; Bury, £38,442; Tottington, £4,192; Unsworth, £3,017; and Whitefield, £3,620. The whole of the acquired undertaking is to be converted for electric traction. A provisional agreement has been arrived at by the local authorities for the working of the traffic. At a conference last week, a proposal by Heywood that each shall reconstruct, electrically equip, and maintain the lines in its own borough was accepted. The Corporations of Rochdale and Bury are to have running powers over the Heywood lines, crediting Heywood with the fares taken over its section, minus a certain proportion for working expenses—say, 5d. per car-mile. This will form the working basis, but details are left for future arrangement. The agreement removes what threatened to be a deadlock.

Glasgow.—The Tramway Committee has approved of a large number of extensions of the system. The matter came up in a report by the general manager, Mr. John Young, who suggested 17 extensions, varying in length from ½ mile to 4½ miles; but recommended that in the meantime power should only be asked from Parliament to construct sections totalling out to 17⅔ miles. In the course of his report, Mr. Young stated that the Committee knew from experience that much could be done by way of tramway extension with electric traction, which could not be undertaken with horse traction, and, in his opinion, no such opportune time as the present would again occur for obtaining powers for laying down a sufficiently wide and satisfactory scheme of extensions. As to his recommendations, the general manager remarked that in designing and equipping the Pinkston power station, these extensions were fully anticipated and provided for, so that the cost of power for running the cars on the proposed extensions, would practically amount to only the expenditure on extra coal and wages, which would be under one-third of a penny per car-mile. It could not be expected that the extensions now indicated as necessary or desirable for the convenience of the community, could be as remunerative as the existing tramways occupying all the very best thoroughfares. But under all the circumstances, he had no doubt whatever that taken as part of the general system, they would prove satisfactory in every respect. The sub-committee on extensions approved of Mr. Young's recommendations. On being submitted to the general committee, however, they gave rise to a long general discussion which, at times, was of a stormy nature. One member, supported by six others, endeavoured, with no success, to get the Committee to agree to give a statement as to how the present extensions beyond the city were paying. Ultimately the meeting adjourned without considering the Baillieston, Uddingston, and Barrhead sections. At the resumption of the meeting, extensions Nos. 1 to 9 were unanimously approved, the remainder being passed on a note. The extensions come before a general meeting of the T.C. for ratification on Thursday, October 6th.

Handsworth.—An end of the dispute between the U.D.C. and the South Staffordshire (Lessee) Co., Ltd., has been arrived at. The terms of payment as to rent, &c,, have been amicably adjusted by the Council agreeing to pay half the cost of relaying the roadway. The agreement was to be signed this week, and it was expected that trams would be running in the district by the 30th inst. (to-day).

Liverpool.—The scheme for constructing a double line of tramways in Edge Lane, and for widening the thoroughfare to properly admit of the construction of the lines, has been set aside by the Tramways, Estate, and Health Committee, owing to the heavy estimated cost of the work, £112,000. The decision does not affect an alternative scheme for providing a single line of tramways in Edge Lane. This scheme is likely to be carried out.

London.—West Ham.—The B.C. has resolved to apply to the B. of T. for sanction to borrow £58,500 for tramway electrification. Out of the issue of £500,000 Corporation stock, which has been wholly subscribed, the borough treasurer stated recently that £127,254 was available for the tramway undertaking. Plans for the electrification of the new routes have been approved, and directions were given for the preparation of specifications for 35 new cars. The Harvey patent signalling apparatus, fixed a short time ago, is to be retained, and another set is to be purchased for use in Upton Lane.

Newcastle-on-Tyne.—There has just been issued to the members of the Corporation Tramways Committee a report as to the preparation of estimates and as to a depreciation fund, and, in regard to the latter, there are embodied reports of the general manager of the tramways (Mr. Le Rossignol) and the city engineer (Mr. Fred Edge). The summary of Mr. Rossignol's statement shows that the total depreciation going on in the present electrical equipment is at the rate of £14,898 per annum. In eight years, which Mr. Rossignol estimates is the average life of the greater part of the items enumerated, this will amount to £119,184, and this can be met by laying aside yearly out of revenue £12,700, and allowing it to accumulate at compound interest at 3½ per cent. Mr. Edge estimates that the depreciation in the permanent way can be met by laying aside £12,000. This makes £24,700, and applies to the present total expenditure of £889,779, and will have to be increased as the capital expenditure increases. The estimate for the year ending March 25th, 1905, is appended, and recommends the formation of a renewal fund, and that last year's surplus should go to form the nucleus of same. The principal figures of the estimate are as follows:—Car-mileage, 4,600,000; total receipts, £206,400; expenses, £70,910; stores, £89,085; maintenance, £31,830; sundries, £18,210; total expenditure, £139,125.

Swindon.—The opening of the Corporation tramways took place on the 22nd inst. On the invitation of the mayor, a considerable company partook of luncheon, and subsequently boarded special cars, which conveyed them to the Town Hall, where the opening ceremony was performed by the mayor. A tour of the newly-opened routes, followed by a reception by the mayor and mayoress at the Town Hall, completed the day's programme. The new routes comprise some 3½ miles; 1,460 yards being double track. The gauge of the track is 3 ft. 6 in., and 105-lb. rails, with "Anchor" type joints have been employed in its construction. The special work, points, crossings, &c., was supplied by Messrs. Hadfield, and is of their special manganese steel. The work has necessitated a considerable amount of street widening and reconstruction. The overhead work is mostly of bracket-arm type, a double trolley wire being employed throughout. The contractors for the permanent way and overhead work were Messrs. J. G. White and Co. Seven cars of the double-deck single-truck type, with seating accommodation for 48 persons, have been supplied by Messrs. Dick, Kerr & Co. Their electrical equipment comprises two 35-H.P. motors and Westinghouse-Newall magnetic brakes; Tidswell's patent lifeguards also being fitted. Car-sheds, containing three tracks, and repair shops, have been provided in the Manchester Road. The traction feeder cables have been supplied by the British Insulated and Helsby Cables Co., and a new traction switchboard of British Westinghouse make, has been installed at the power station. A portion of the routes is lighted by arc lamps fixed on the tramway poles, and certain awkward sections of single track are provided with signals, to be operated by the conductor. The cost of the undertaking amounted to some £37,000, and the work was carried out to the specification of Messrs. Lacey, Sillar & Leigh, consulting engineers, and under the supervision of the borough electrical engineer and tramway manager, Mr. J. G. Griffin.

TELEGRAPH AND TELEPHONE NOTES.

German Cable at Constantinople.—A Dalziel dispatch from Paris says that an understanding has been come to in respect to the position and working of the cable between Constantza and Constantinople, and the agreement will be signed very shortly. The Eastern Telegraph Co., notwithstanding the support of the British Embassy, has been unable to thwart the German project.

The Iceland Cable.—A Press dispatch says that the Great Northern Telegraph Co. has contracted with the Danish Government for the establishment of a telegraph line to Iceland. The company pays all the expenses of the cable, which is to be ready in two years. The Danish and Icelandic Governments pay a subvention of £5,000 a year for 20 years to the company. Permission has been obtained from the British Government to land a cable in the Shetland Islands, and this will be in communication with the existing cable from Shetland to Scotland. From Shetland a cable will be laid *viâ* Thorshavn, in Faroe, to the east coast of Iceland. Thus Iceland will again have a main line from the east coast to its capital, Reykiavik. The company is to commence the work immediately.

The New German-Dutch Cable in Asia.—The budget for the Dutch Indies, which has been placed before the Second Chamber at Amsterdam, contains further information respecting the German-Dutch Telegraph Co., which was formed a few months ago. It appears that the company proposes to lay the proposed cable from Menado to Guam in the middle of 1905, and to complete the connection to Shanghai about the end of the same year. The company, it is said, has asked the Dutch Government to discontinue (?) the Dutch subsidy as soon as the line from Menado to Guam has been opened to traffic.

Pacific Cable.—The following article appeared in the *St. James's Gazette* of 26th inst.:—

"The long-delayed conference on the question of the Pacific cable has now been fixed to take place in the first fortnight of November in London. The partners are to be represented as follows:—

"Great Britain by the Colonial Secretary.

"Commonwealth of Australia by Lord Jersey.

"Canada by Sir William Mullock.

"New Zealand by Sir Sandford Fleming.

"The members of the Pacific Cable Board, including some of the Agents-General, have also been invited to attend, but they will not be entitled to vote.

"This conference was advocated by Mr. Chamberlain when he occupied the post of Colonial Secretary. It has become necessary owing to friction arising over the working of the cable. The principal question to be discussed is whether a contract which has been entered into by New South Wales with a private company is in accordance with the honourable understanding entered into by the Imperial partners at the time the construction of the cable was decided upon. Another question is with regard to the amount charged for terminal fees in Australia. It is contended by Great

Britain and Canada that the policy which has been pursued by Australia as a whole with regard to the management of the cable has not been in the best interests of the movement nor fair to the other partners. Concessions have been given to a private company which, up to the present, have been refused to the Pacific cable management. The principal objection is to the granting of a special landline, which is being maintained at the public expense. Both Great Britain and Canada also contend that the terminal charge—5d. a word—is far too high. Last year Australia, from this source alone, got £10,000 out of the Pacific cable. Considering that Australia pays 50 per cent. less for cable charges than she did when she had to give a private company the subsidy, it is thought both in Britain and in Canada that the Pacific cable should be at least placed on the same footing as the private enterprise."

Seeing that practically the question is still under consideration, it will be well, perhaps, to withhold detailed comment until all charges made along the route of the Pacific cable have been examined. There is no doubt that they are rather high; but still we take it that cables are not usually laid till connections and their cost have been determined.

Swansea Telephones.—At the last T.C. meeting, Mr. David Davies announced that, as the National Telephone Co. would not meet the Corporation in a reasonable manner on the subject of intercommunication, there was no alternative but to take legal proceedings to compel the company to do so, and the action would be instituted at the end of the long vacation.

Italian Telephones.—The Italian Government has set aside a sum, amounting to lire 1,300,000, to be devoted to the installation of telephone lines making use of the Pupin system, between Naples, Rome and Turin.

Telegraphic Interruptions and Repairs :—

Cables.	Interrupted.	Repaired.
Trinidad-Demerara	Aug. 26, 1901	
Dominica-Martinique	May 7, 1902	
St. Lucia-Martinique	May 7, 1902	
Cayenne-Pinheiro	Aug. 13, 1902	
Reissa-Issa (Yemen)-Camaran	Oct. 22, 1902	
Tarifa-Tangier	Jan. 18, 1904	
Closed { Vladivostock-Nagasaki	Feb. 9, 1904	
Closed { Port Arthur-Chefu	Mar. 9, 1904	
Paramaribo-Cayenne	July 13, 1904	
Cape Haitien-Mole St. Nicholas	Aug. 20, 1904	
Bundaberg-Gomen (New Caledonia)	Aug. 30, 1904	
Marseilles-Barcelona	Sept. 16, 1904	
Cape Haitien-Puerto Plata	Sept. 26, 1904	
Landlines.		
Cartagena-Baranquilla	Dec. 8, 1900	
Puerto Bairros	July 28, 1902	
Seoul-Masampo	Feb. 18, 1904	
Seoul-Gensan	Feb. 18, 1904	
Anju-Ping-Yang	Feb. 25, 1904	
Ninguta-Vladivostock	March 3, 1904	
Caimanera-Santingo	June 15, 1904	
Kertch-Soutehoum	Sept. 27, 1904	
Fao route beyond Bagdad	Sept. 24, 1904	Sept. 24
Saigon-Bangkok	Sept. 26, 1904	

CONTRACTS OPEN AND CLOSED.

OPEN.

Antwerp.—October 15th. The Municipality of Ghent invites tenders for the construction of 10 electric cranes at that port in accordance with the specification, a copy of which may be seen on application at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Barrow-in-Furness.—October 18th. Arc lamps, columns, bases, switches, &c. See "Official Notices" to-day.

Brighton.—October 10th. Advertising rights for the electric cars. See "Official Notices" September 23rd.

Carlisle.—November 1st. Two Lancashire boilers, two 50-kw. and one 30-kw. steam dynamo, 5-ton travelling crane, economiser, cables and boxes, wiring of buildings, switchboards, motors, fans, &c, for the Cumberland and Westmoreland Lunatic Asylum. See "Official Notices" to-day.

Great Western Railway.—October 17th. Tenders for a year's stores. For list of electrical sections see "Official Notices" to-day.

Hull.—September 30th. The Corporation invites tenders for the wiring and fitting of Beverley Road Baths. Forms of tender at the City Engineer's Office.

Ilford.—October 4th. Balancer and switchboard panel; reversible booster and panel, for the U.D.C. See "Official Notices" September 16th.

London.—October 4th. Three electric car traversers for the L.C.C. See "Official Notices" August 5th.

London.—October 4th. The L.C.C. wants tenders for centrifugal and other pumps for Greenwich power station. Particulars from Mr. G. L. Gomme, County Hall, Spring Gardens, S.W.

London.—October 11th. Electric wiring, &c., for the Ranger's House, Blackheath, for the L.C.C. See "Official Notices" to-day.

Manchester.—October 4th. Ampere-hour and watt-hour meters for the Electricity Department. See "Official Notices" September 23rd.

Middlesex.—October 12th. The Light Railways Committee of the Middlesex County Council invites tenders for the work and materials required in the construction of the permanent way (for electric traction), bridge work, and road widenings connected with a number of light railways. See our September 23rd issue.

Richmond.—October 5th. Pumping machinery and electric motors for the Sewerage Board. See "Official Notices" September 16th.

Rochdale.—October 10th. Ejector condensers, circulating pumps, piping, &c. See "Official Notices" to-day.

Roumania.—Tenders are about to be invited for the electric lighting of the town of Caracal.

Salford.—October 6th. Lead-covered cables for the Electricity Committee. See "Official Notices" September 16th.

Shanghai.—March 31st, 1905. The Board of Trade have received through the Foreign Office a copy of a telegram from the British commercial agent in Shanghai to the effect that tenders are invited by the municipality of that city for the construction and working of 24 miles of electric tramways on the trolley system, double or single. Conditions, plans, &c., on application to Messrs. Pook & Co., agents for the municipality of Shanghai, 63, Leadenhall Street, E.C.

Spain.—October 12th. The Municipal Authorities of Espinar (province of Segoria) are inviting tenders for the concession for the electric lighting of the town. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Espinar (Segoria).

Spain.—October 13th. The Municipal Authorities of Almendralejo (province of Badajoz) are inviting tenders until October 13th for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders are to be sent to, El Secretario del Ayuntamiento de Almendralejo (Badajoz).

CLOSED.

Admiralty.—Bell's Asbestos Co., Ltd., have again received the contract for the supply to the Admiralty of a number of their specialities.

Bradford.—The Electricity Committee has placed an order for another 1,000-kw. low-speed engine and condensing plant for its generating station with Messrs. Cole, Marchent and Morley, Ltd., of Bradford.

Croydon.—The T.C. has accepted the tender of Messrs. Mason, Scott & Co., Ltd., for the supply of water purification plant at the E.L. works, at £519.

Maidstone.—The T.C. received the following tenders for the supply of feeder cables :—

St. Helens Cable Co., Ltd.	£576
W. T. Henley's Telegraph Co., Ltd.	490
W. T. Glover & Co., Ltd.	480
Callender's Cable and Construction Co., Ltd. (accepted)	472

Southend-on-Sea.—The T.C. has accepted the tender of Messrs. Rawlinson & Sons, of Blackburn, for the supply of a motor tower wagon, at £330.

West Ham.—The Corporation received on Tuesday the following tenders for the electrical equipment of the High Street, Romford Road and Leytonstone Road tramway lines :—

Macartney, McElroy & Co.	£4,911 10
The Borough Electrical Engineer	4,887 5
Dick, Kerr & Co.	4,579 2
British Electric Equipment Co.	4,567 13
British Insulated & Helsby Cables, Ltd.	4,502 2
Brush Electrical Engineering Co.	4,141 2
R. W. Blackwell & Co. (accepted)	3,851 0

FORTHCOMING EVENTS.

Monday, October 3rd.—At 7.30 p.m. Society of Engineers' meeting.
Thursday, October 6th.—At 8 p.m. Rugby Engineering Society. Annual General Meeting. Discussion on the "Metric System," to be opened by Mr. E. R. Briggs, and replied to by Mr. R. C. Jackson.
Friday, October 14th.—First Electro-Harmonic Concert of the Season.

Carbide of Calcium.—The Usines Electrochimiques de Hafslund is the title of a new company which has been registered at Geneva, with a share capital of £48,000, for the purpose of acquiring and working a carbide of calcium installation at Hafslund, Norway. The composition of the board of directors shows that the Schuckert Co., of Nuremberg, which is already interested in two undertakings at Hafslund, is also at the back of the new company.

APOLOGY.

IT has just come to our knowledge that, by an error on the part of one of our Directory staff, an entry appears in the current edition of the Universal Electrical Directory referring to the Electrical Publishing Co., Ltd., as "in liquidation." We find, on inquiry, that the Company is carrying on business in the ordinary way, and that there has been no interruption of it, and the statement is entirely inaccurate.

We regret exceedingly if any inconvenience has been caused by our mistake.

H. ALABASTER, GATEHOUSE & Co.,
Publishers,
The Universal Electrical Directory.
4, Ludgate Hill, E.C.

NOTES.

Municipal Tramways Association.—The report of the proceedings of the Tramways Convention up to Tuesday evening, appears on pp. 555-558. The Conference was resumed on Wednesday morning, and after the general business of the Association had been transacted, and Mr. Baker's revised report on the hours of labour, &c., of tramway employés, had been presented, and lightly commented upon, the paper by Mr. Aldworth, of Nottingham, on "Cars: their Equipment and Maintenance," was read by the secretary. This was a good paper, and raised many points for discussion, but the time was limited, and only Messrs. Le Rossignol, Spencer, Tittensor, Snell, and one or two others had anything of a critical nature to say. Mr. McElroy's paper on "Overhead Equipment: its Construction and Maintenance," was left unread, but it will appear in the *Proceedings* of the Association, and be discussed at a managers' meeting in Birmingham next May. A hearty vote of thanks was tendered to Mr. Bellamy for the admirable manner in which he had carried out his duties, to which he responded briefly in a few well-chosen words. The Conference then terminated, and the afternoon was spent in visiting the Corporation's Lambeth Road works and Lister Drive power station. In the evening, the annual dinner of the Association was held in the London and North-Western Hotel; but as this is purely a private function, we can do no more than give it a passing mention. Thursday was devoted to trips by tramcar, a drive to Knowsley Hall, and a cruise round Liverpool Bay. Special praise should be accorded to the secretary, Mr. McElroy, to whose tact, courtesy and unflagging energy the success of the Conference is in no small measure due.

Mr. A. Baker, general manager of the Birmingham Corporation Tramways, was elected president for next year, and Mr. J. B. Hamilton, of Leeds, as vice-president. The 1905 meeting, however, will be held in London in July, as the Tramways Exhibition is to be held here at that date. The name of the Association has been altered from the Municipal Tramways Association of Great Britain, to the Municipal Tramways Association, chiefly because Belfast has lately entered the roll of membership.

Liverpool—Southport Electric Railway.—Our Southport correspondent says that this week the extended and completed service of electric trains plying between Southport and Liverpool has been inaugurated. There are only one or two steam trains left running. The time taken to cover the journey from Liverpool to Southport is about 37 minutes by the ordinary electric trains, against 55 minutes by the old steam trains, thus saving 18 minutes each journey. The electric expresses do the distance in 25 minutes, compared with 35 by the steam expresses.

Appointments Vacant.—Junior assistant for Accrington Electricity Works (25s.); clerk for the Weymouth and Melcombe Regis Electricity Department (£80); resident electrical and tramways engineer for Pontypridd (£300); assistant engineer for Crewe electricity works (£80).

Stealing Electricity.—At the Durham Police-court on the 21st inst., George Savage, of Tudhoe Grange, was charged with stealing electricity, the property of the Northern Counties Electricity Supply Co. The evidence showed that the defendant had a slot meter in his house, and that by using a hairpin he was able to get a connection without the electricity going through the meter. The manager of the works saw the lights burning in the defendant's house for a number of nights. He afterwards examined the meter, and found only a few coppers in, whereas he would have expected to have found at least 3s. 6d. A fine of £2 and costs was imposed.

Failure of an Earth. — As an example of the sensational fiction with which the readers of a well-known Sunday newspaper are regaled, we think the following will be hard to beat: —An extraordinary failure of the electric light occurred last evening in the Strand and district. It appears that the power house close to Cambridge Circus was suddenly enveloped in a blaze of light after 6 p.m., and in spite of the careful installation of all the vital parts, a man named Harry Scott was overcome by the fumes of the burning rubber installation which was started smouldering by the sudden failure of an "earth." Before he could switch off the current the power house was filled with smoke and fumes. The fuses, having their protection burnt away, melted, and the current which should have supplied the north part of the Strand wasted itself. Scott was found unconscious on the floor of the power house, which at this time was a smouldering inferno. The installation not lending itself to an outbreak of flame had devoured the casings and the metal fittings. Scott was taken to the hospital, where after some time he was restored to sensibility.

Chinese Notions about Electric Light.—The following essays, written by Chinese boys in the Penang Free School, have been forwarded to us by Mr. A. H. Preece, and are noteworthy as showing the intelligent interest displayed by them in this mysterious agent:—

THE ELECTRIC LIGHTS.

The electric lights are lights evoked by fire with a kind of fluid. The electric lights in Penang are commenced making by the Government on the 19th of April, and stops at the end of July. The electric lights kindled on the 1st August through George Town, ended from Northam Road to the end. How is the way electricity to be made? First dig out the earth from the ground, making a long trench and surround with bricks on all sides. Afterwards put long wires, at the end of each is fastened with a screw, and joining it with the screw to one another. CHIN BENG.

We have never seen the electric light before. In this year 1904, the electric light began to put. The light is very light and able to see anything on the ground. It is lighter than the gas. It is lighted about six o'clock in the evening. When it is lighted we can see the insects flying around it. There is a round glass which covered the light is called a globe. The globe is well tied up so that it cannot break. In the morning the man came and put the stairs against it, and climbed up to the top and took the globe off and cleaned it very slowly. After cleaning it, he put it on again and go to another place. When the night came on the light became lighter. It is built up like a post, and bent down on the top. TIANG LEAT.

The electric is a pretty light of all the other. We have just seen the electric light in Penang on the 1st of July. The electric light began to put by Howarth Erskine. The electric light is very useful, because all the people like it. When the time at six o'clock the electric light is lighted up. The electric light is just the same of moon bright. The tube was used to carry lights to the lamps. The electric office of Penang is in Kwala Kangsa Road. In the office there is a fan for stimulating the people in the office.

ENG KHENG.

South African Notes.—(From our Durban correspondent):—

Cape Town (Cape Colony).—The Committee of the Cape Town Council has recommended the adoption of the proposals of the electrical engineer that the maximum price per unit for night supply be reduced to 1s., the minimum to remain as before, at 8d.; also the day supply at half-rate, as usual. This is proposed to take effect from October 1st next.

Potchefstroom (Transvaal).—The Town Council has decided on the purchase of the Potchefstroom Consumers' Electric Light & Power Co.'s Lighting Works, with all plant, rights, &c., for the sum of £10,000.

Transvaal.—It is stated that the Transvaal Government has sanctioned an expenditure of £13,000 on telephone materials.

Heating of Three-phase Cable Sheaths: Errata.—Owing to the miscarriage of proofs, for which we were solely to blame, we regret that several printer's errors occurred in Mr. M. B. Field's article on this subject in our last issue; the following corrections should be made:—

Page 486.—In connection with expression (4), for "The current at the point Δ, θ," read "the current-density at the point Δ, θ."

Expression (5), should be—

$$\frac{1}{\rho}\int_{\Delta_2}^{\Delta_1}\int_{0}^{2\pi}\frac{dk}{d\theta}\cdot\frac{dk}{dt}\,d\Delta\,d\theta \text{ dyne-cms.} \qquad (5)$$

$\left(\frac{dk}{d\theta}\cdot\frac{dk}{dt}\right.$ has been omitted.$)$

In expression (8), for $\frac{b^8}{16\,\Delta^4}$ read $\frac{b^8}{16\,\Delta^8}$.

Page 487.—In expression (10), the multiplier of the series is—

$$\frac{36\,\pi^3\,c^2\,f^2\,b^2}{\rho}.$$

Shock Fatalities.—An inquest was held at Ferryhill, Durham, on the 21st inst., into the circumstances attending the death of Thomas Lee, who was killed at the Dean and Chapter Colliery on the 17th inst. Stephen Liddell, a stoneman, said that on the 17th inst. Lee and he came to the shaft, and the former took hold of the rapper to signal that they wanted to ride. The moment he touched the rapper cord, he shouted: "Pull me off!" Witness got hold of Lee, and pulled him away. As he did so, he got a severe electric shock, and they both fell to the ground. Lee appeared to be convulsed, and only breathed for 10 minutes, and then died. The rapper cord or wire would be about 6 in. from the electric cable, but he could not say whether Lee got hold of it.

Stanley G. Smith, electrician, said he superintended the putting in of the wires, which were temporary ones. The insulation of the cable as it passed down the shaft was complete as far as he knew. The rapper wire was a naked one. After the accident, he made an examination of the cable; he could see nothing wrong with it in the shaft, but, on testing it, he found there was a slight leakage somewhere. The pressure of the current was 220 volts, which would give a severe shock when standing in a damp place. The coroner, Mr. J. T. Proud, said there was not the slightest doubt that the man had been electrocuted, and a verdict was returned accordingly, a rider being added that the jury were of opinion that cable rapper and other ropes should be kept sufficiently apart from danger, or some other means of complete insulation should be adopted.

James Thompson, aged 18, employed by the Scarborough Electric Light Co., while at work in a transformer sub-station on 27th inst., received a shock which caused his death.

Electric Mail Vans.—The French Postal and Telegraph authorities in Paris are about to put in service 15 electrical motor-vans, of which 12 will be constantly at work, the remaining three being kept in reserve in case of breakdown. The vehicles, which weigh complete 1 ton 11 cwt. 70 lbs., are designed to carry a load of between 12 and 13 cwt.; they are propelled by a single electric motor connected to the rear road-wheels by chains. A special plant has been installed at the G.P.O. in Paris for the charging of the accumulators.

Wire Drawing of Steam.—In connection with the note which appeared in our last issue upon this subject, Mr. C. Alfred Smith, of the Engineering Department, King's College, London, writes to us to point out that the practice has been adopted for some years, apparently with success, in the Royal Navy. For instance, the engines of the *Terrible* were designed to work at a pressure of 210 lbs. at the stop-valve, but steam is generated in the boilers at 250 lbs. He believes that he is correct in stating that in many cases in the Navy the steam is generated in the boilers at 300 lbs. per sq. in., and is used at 210 lbs. at the engine stop valve. At the meeting of the Institution of Mechanical Engineers on July 22nd, during the discussion on Mr. E. G. Hillier's paper ("The Design and Test of a Modern Steam Plant"), Mr. Smith asked Mr. Hillier whether, in the course of his experience, he had ever come across similar practices on land, for if it were possible to design boilers which would work with safety at a pressure of 300 lbs. per sq. in., and to fit reducing valves which were apparently reliable and automatic in action, then it seemed to him better to do this than to fit superheater tubes, which were in some danger of being burnt, owing to the vagaries of stokers who indulged in uneven firing. At the same time, Mr. Smith now points out that, where it is desired to use the maximum temperatures of superheat possible, separate superheaters are compulsory. Mr. Smith states that, in the course of a conversation with one of the engineers of the *Terrible*, he suggested that possibly all the trouble with the failing joints on the Belleville boilers was due to the very high pressure of 250 lbs. at which they were worked. But the engineer assured him that there was exactly the same trouble at lower pressures. On a cruiser of the *Diadem* class, Mr. Smith saw the gauge pointers well above the 250 lbs., and one of the engineers of that ship said that they never experienced any trouble with leaky joints. Without in the least wishing to defend the action of the Admiralty in fitting Bellevilles, he has often noticed the difference in the expressions of opinion concerning these boilers from various naval engineers, and he has invariably found that those who complained of them bitterly were the men who were shipmates with the boilers fitted in the early days. In short, he had come to the conclusion that it was more a question of workmanship than pressure. If, therefore, as seems to be the case, it is possible to use such high-pressure boilers for marine purposes, why are they not used for central stations? For the real value of superheating seems to lie in the reduction of the wetness of the steam, and this the reducing valves seem to accomplish satisfactorily. Moreover, for central station work, reducing valves would prevent the fluctuation of steam pressure at the boiler affecting the engine; for those who have worked in central stations know full well that the average stoker is a being not to be relied upon. And the effect of a fluctuating steam pressure—it is usually at the peak of the load that it is worse than usual—upon engines, however well governed, is a busy time with the rheostats. Mr. Smith was surprised that Mr. Hillier could not quote a case of the use of such high-pressure boilers, and hopes that some readers of the Electrical Review will inform him of any case where they have been tried for central station work.

The Best Current Density and Pressure.—Engineers intending to install a power transmission plant have to solve the following problem:—The effective output desired being given, what amount of plant should be installed at the generating station situated at a given distance from the receiving station, and what should be the cross-section of the mains in order to obtain the minimum value for the outlay and the cost of energy at the receiving station? In a recent lecture before the International Society of Electricians (see *La Houille Blanche*, July, 1904), Mr. Swyngedauw draws attention to the fact that instead of following Lord Kelvin's rule for the most economical density, it is preferable to manage a plant with a given output with a view to deriving the highest possible profit from the same, this leading to the following problem:—A generating station of a certain output being given, under what conditions should the energy be transmitted to the receiving station so as to allow of the plant being operated with the highest benefit? After enunciating this problem in the shape of an equation, the author suggests the following rule:—If the pressure of the power transmission at the starting point of the conductor be given, as well as the capacity of the plant installed at the generating station, the most advantageous cross-section to be given to the transmission line will be such as to make the selling price of an amount of energy equivalent to the energy loss along the line just equal to the amortisation of the cables constituting the same. For copper conductors at 2s. per kg., and an amortisation amounting to 8 per cent., the most profitable densities would be (amps. per mm².)—

0·948	with a selling price	per	KW.-year	of 80s.
0·774	"	"	"	120s.
0·670	"	"	"	160s.
0·540	"	"	"	240s.
0·424	"	"	"	400s.

The most favourable density as obtained by the author's method is smaller than the most economical density as derived by Lord Kelvin's method. In the case of energy being transmitted by transformers at the starting and arriving points, the current density being given, and the generator chosen, the efficiency of the line is known to be more satisfactory as the transmission pressure is higher, while the price of the transformers, both at the starting and arriving points, will increase with the pressure adopted; it is thus easily seen that there will be a certain pressure, most satisfactory for transmission. According to Mr. Swyngedauw, this most favourable pressure would be such as to make the amortisation of the increase in the price of the step-up and step-down transformers, involved by the increase in pressure, equal to double the amortisation of the cables transmitting the current.

Electrolytic Reduction of Carbon Dioxide.—Herren A. Coehn and S. Jahn have published in the *Berichte* of the German Chemical Society (1904, xxxvii., 2,836), a brief summary of the results of some experiments they have carried out upon the above-mentioned subject. As carbon dioxide (carbonic acid) cannot be electrolytically reduced in an acid solution, it is not the undissociated molecule upon which the hydrogen acts; and as reduction does not occur in the solution of a normal carbonate, the CO_3 ion there present does not undergo change. Since, however, solutions containing bicarbonates can be reduced, it must be the ion HCO_3 which suffers reduction. Electrolytic reduction of carbonic acid takes place in presence of such electrodes as are charged with hydrogen at high potential. The only product obtained at any potential (at which reduction is to be noticed) is formic acid; and in certain prescribed conditions the yield is quantitative.

Electrical Separation of Oil from Water.—The "electrical" process for separating lubricating oil or grease from the condensed water of engines, invented by Mr. D. Perrett, has been described recently in a German paper. A wooden tank, 3·6 metres long, 0·6 metre wide, and 0·75 metre deep, is provided with a set of iron plates, arranged diagonally with respect to the length of the vessel, and these plates are alternately connected with the positive and the negative poles of a source of direct current, which is said to be used at a pressure of 150 volts. The liquid comes from the condenser as a turbid emulsion, not amenable to filtration; but, after passage through the tank, the oil can be recovered by means of a filter constructed of wood-wool, sand, and sawdust. The process is stated to have been in regular employment at a factory for 18 months, the consumption of energy being 0·5 KW.-hr. for 1 cubic metre of water.

Stress in Steel.—A considerable outcry has been raised over a boiler of marine type, two plates of which cracked in a direction almost parallel with the length of the boiler. The crack opened wide—a good half inch. The *Engineer* points out that the disturbing element in this fracture is that it runs into two plates. A fracture in one plate is a sign of initial stress, and is looked on as the result of some oversight. Thus it might happen to a plate which had been laid to cool on the platemill floor, and the middle of which had been kept hot by a smaller hot plate laid upon it. Thus the outer boundary of the under plate would become fixed, and when the middle area cooled it would be put into a state of severe tension. The cracking of two plates after being built into a boiler may be truly alarming, but, after all, it may have been due to the inevitable coincidence which at some time or other must bring two bad plates together, if bad plates are being made at all.

The samples cut from the plates show approved qualities, yet the whole plates crack like sheets of pot under hydraulic stress. We are not told if the hydraulic test was applied hot. It is quite possible that the boiler might not have fractured under steam pressure, when we may be assured the plate would be less brittle. We see no marvel in the plate showing no reduction of area at the line of fracture. The fracture very probably started at a rivet hole, and in a homogeneous material like steel plate under stress, such a crack once started would continue by tearing, and area reduction would not tend to occur.

It is suggested that a freshly rolled plate should be dropped through a slot in the floor into a cell beneath, where it would cool off equally. It is, of course, by unequal cooling that initial stresses are set up, and were it possible to cool a plate with absolute uniformity throughout, it would have no initial stresses. Is not the whole matter one of care? Nowadays accidents are so rare that it is possible that less care is exercised than should be. Were fractured plates frequent, a freshly-rolled plate would be laid in wood ashes to cool, and carefully covered up with the ashes.

The boiler which failed was made in Canada from plates rolled in the United States; the plates were 1 in. thick. It might be interesting to have an inspection made of the conditions under which these plates were rolled and cooled. There may have been some carelessness allowed to creep in with the general "hustle" supposed to be a feature of American works.

Tramways and Light Railways Association.—In the *Official Circular* for September are given the Model Bye-laws Regulating the Stopping, &c., of Tramcars, the last Board of Trade Regulations under the Electric Lighting Acts, and under the Provisions of Special Tramway Acts, or Light Railway Orders. It is notified that the following lectures will be given at the Society of Arts, John Street, Adelphi, viz.:—"Automatic Regenerative Control for Electric Traction," by Mr. J. I. Hall, on October 20th; "Notes on Permanent Way," by Mr. A. N. Connett, on November 3rd; and "Running Powers," by Mr. Stephen Sellon, in December; also that members of the Association have been invited to visit the various works of the London County Council Tramways on November 11th.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the power station or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*]

Central Station Engineers.—The Luton T.C. has increased the salary of Mr. COOKE, the borough electrical engineer, from £204 to £234. The Committee proposed that the figure be £250, but after a long discussion £234 was decided upon by a vote of 10 to 9. Councillor Wilkinson, the chairman of the Committee, tendered his resignation in consequence.

Mr. A. J. RYAN has been appointed chief assistant engineer at Gillingham (Kent) Borough electricity works at a salary of £150 a year.

On leaving the service of the Dundee Corporation electrical department to take up another appointment, Mr. JOHN M. NEWTON, assistant, was presented with a token of respect from the office and engineering staff of the works.

Mr. JOHN MCMILLAN, resident electrical engineer of Falkirk Corporation, has been made the recipient of a handsome silver tea service, a silver tea caddy, and a silver-mounted tea tray, by the senior burgh officials, as wedding gifts.

Mr. W. A. GILBERT, of the Ealing electricity works, has been appointed mains assistant at West Ham.

At a meeting of the Willesden District Council on Tuesday evening Mr. JOHN GEO. BRUCE, assistant distributing engineer to the St. Pancras Borough Council, was appointed resident electrical engineer.

Mr. J. DOUGLAS KNIGHT, borough electrical engineer of Ealing, has this week returned from his visit to America.

Electric Tramway Officials.—The following have been selected to appear before the Oldham Corporation Tramways Committee in reference to the appointment of a general manager of the tramways, at a commencing salary of £300 a year:—Mr. J. Dugdale, general manager and engineer of the Oxford and District Tramway Co., Ltd.; Mr. John Telfer, manager of the Warrington Corporation Tramways; Mr. Alfred Wolstencroft, traffic superintendent of the Oldham Corporation Tramways; Mr. L. Slattery, general manager of the Blackpool, St. Annes and Lytham Tramway Co.; Mr. G. B. Spurr, tramway manager at Ilford; Mr. Wm. Hutchings, traffic manager of the South Lancashire Tramway Co., Atherton.

The members of the Huddersfield Tramways Committee have presented a piece of silver plate to the retiring general manager of the tramways, Mr. H. N. THOMAS.

Mr. PALLISTRELLI, manager of the waterworks, has been appointed to succeed Mr. E. F. FOOTE, manager of the Lourenço Marques electric tramways, resigned. Mr. Foote has left for England, and prior to his departure was presented by the employés with a diamond scarf-pin and gold-mounted cigar mouthpiece, as a mark of appreciation.

General.—The Telephones Committee of the Glasgow Corporation has decided to recommend the appointment of Mr. J. S. PATERSON, who is at present in the National Telephone Co.'s service, as chief electrician, at a commencing salary of £190.

We learn that Mr. BERTRAM S. GILES, M.I.E.E., who was for many years responsible for the design of Messrs. Mather & Platt's electrical machinery, and acted as their technical representative and adviser, has now joined Messrs. Johnson & Phillips as manager of their electric light and power works, for the manufacture of generators, motors, transformers, resistances, switchboards, arc lamps, &c.

The Sydney (N.S.W.) E.L. Committee has decided to recommend the appointment of Mr. T. ROOKE as chief engineer, at a salary of £900 per annum.

Mr. W. L. KING, A.M.I.E.E., was to leave by the ss. *Orita* yesterday for Valparaiso, Chili, to take charge of the Electrical Department of Messrs. Balfour, Lyon & Co., who are agents for Messrs. Scott and Mountain, Ltd. Mr. King was until lately with Messrs. A. W. Penrose & Co.

Obituary.—MAJOR-GENERAL WEBBER.—Our readers will learn with regret of the death, which occurred on September 23rd, of Major-General Charles Edmund Webber, C.B., R.E. Major Webber was born in 1838, so was 66 years of age. He saw service in India during the Mutiny, in South Africa during the Zulu Campaign, and with the Egyptian Expedition of 1882 he was in charge of the telegraph lines. It was for service at the battle of Tel-el-Kebir that he was made a C.B. In electrical and telegraph circles the deceased gentleman will be remembered first and foremost for the part which he played as a founder of the old Society of Telegraph Engineers, now the Institution of Electrical Engineers, of which he was President in the year 1882. It was only in May last that the Council of the Institution paid him the rare honour of electing him to be an honorary member. Those who are in the habit of attending the meetings of the I.E.E. in London will miss him from future gatherings, for his voice was generally heard in the course of most of the discussions. And the same remark applies equally to the meetings of Section G of the British Association, where his was a very familiar figure. Indeed, he was a prominent member of the section at the meeting of the Association which was held at Cambridge only a few weeks ago, and for part of the time, in the unavoidable absence of the Hon. C. A. Parsons, he presided over the proceedings. He had read a number of papers before the Institution of Electrical Engineers on telephone, telegraph and electric lighting matters, some of which are published in back numbers of the ELECTRICAL REVIEW. He was a juror of several electrical exhibitions between 1880 and 1890. Turning to the commercial side of his connection with electrical engineering, we should mention that for some four or five years he was either managing or consulting engineer and director of the old Anglo-American Brush Electric Light Corporation. He was at one time chief engineer of the City of London Electric Lighting Co., and had been on the board of the Chelsea Electricity Supply Co., we believe, from its commencement. One of the matters with which he had interested himself during the present year was the movement for the resuscitation of the old Dynamicables after 15 years' suspended animation. A funeral service was held on Wednesday morning last, at 10 o'clock, at the Brompton Parish Church, S.W. The service was fully choral, and was attended by a considerable number of the late General's colleagues on the Council of the Institution of Electrical Engineers, among them being Mr. Alex. Siemens, President-Elect; Prof. Ayrton, Dr. Swan, Dr. S. P. Thompson, Past-Presidents; Dr. Fleming, Mr. J. E. Kingsbury, Mr. W. M. Mordey, Mr. W. H. Patchell, Vice-Presidents; Mr. F. Gill, Mr. S. Morse, Members of Council; Major O'Meara, R.E., Mr. Fleetwood, Members; Mr. F. H. Webb, former Secretary; and Mr. Rowell, Assistant Secretary. There were also present Colonel Baresford, R.E., and Colonel Slacke, R.E. The interment subsequently took place at St. Margarets, Lee, Kent.

PROF. NEILS FINSEN.—During the last few days the world has been filled with expressions of profound grief at the death of Prof. Finsen, and writers and the general public everywhere have been unanimous in their praises of the work which had made him famous. His life was a short one—only 43 years—lived modestly and unselfishly and largely in retirement, for he was afflicted and in a weak state for some years, but he had lived long enough to know that his invention of lupus light treatment had earned for him the gratitude of thousands of sufferers for whom medical skill had previously been quite unable to prescribe an effectual cure. So far as the discovery, which dates back to 1893 to 1895, and the details of the process, are concerned, there is little need to dwell upon them here, for we have described them in many articles in the ELECTRICAL REVIEW. We may, however, for the benefit of those whose interest in the subject may have been revived by the sad death of the Professor, mention one article on "The Treatment of Lupus by Arc Light" in our issue of July 12th, 1901, in which we outlined the work of the inventor which led up to the discovery that light contains bactericidal properties, and described by the aid of photographs the application of the treatment. It was in 1896 that Finsen was first enabled to apply his treatment to the suffering public at Copenhagen in a building erected in the grounds of the Municipal Hospital, but later by the aid of wealthy friends and with the assistance of the State (which made him a loan free of interest) he was able to establish the now renowned Finsen Institute which to-day has a staff of half a dozen doctors and 60 nurses, and has treated some 2,000 patients from all parts of the world. Last year the Nobel prize of 100,000 crowns was awarded him in recognition of his work, but it was characteristic of the man that, although personally poor, he only accepted one-half of the sum, and that for the benefit of his family, the remainder being set apart for the work of the Institute. The interest which Queen Alexandra (then the Princess of Wales) took in the work of Finsen is well known, and the first set of apparatus used in this country was introduced at her own cost at the London Hospital. Numerous other hospitals have since followed suit and installed similar apparatus, as the true value of the light cure for lupus and like affections has become more widely appreciated. The German Emperor is said to have suggested that a monument should have been erected to Prof. Finsen during his lifetime, but this, it seems to us, would hardly have been in accord with the Professor's modest nature, and he needs no monument of stone to perpetuate his memory. He has erected a monument in the hearts of men by the very real instrument which his scientific and medical research has placed in the hands of humanity for the relief of sufferers from a disease as loathsome as it was formerly difficult to remove.

MR. H. A. WILLEY.—The *Times* reports the death at Exeter, at the age of 41, of Mr. Willey, who carried on business as a gas engineer and manufacturer of gas and electric lighting plant. He founded the manual training school, endowed scholarships, and promoted in many ways the facilities for education at Exeter. Among many other notable acts of generosity, he provided at his own cost the funds for lighting Exeter Cathedral by electricity.

ELECTRIC TRAMWAY ACCOUNTS.

Leeds Corporation Tramways.

The returns of the Leeds tramways undertaking contain much interesting information relating to the excellent results of the past year's working, for which all credit is due to Mr. J. B. Hamilton, the general manager. The system, which covers all the main thoroughfares in the city, remained practically stationary in mileage last year, but some 12 miles of additional routes to outlying districts are authorised or under construction, and this has resulted in the decision to install turbo-alternators for generating purposes and transforming sub-stations at suitable places on the extended routes.

The year's working shows if anything the growing popularity of the tramway services, increased car-mileage having augmented both the traffic and average income. Working expenses per car-mile are only fractionally higher, and to the increased financial charges is due the slight reduction in surplus compared with the previous year. It is noted in the report that the ticket system has been substituted for the box system, with excellent financial results.

General Statement.

For 12 months ending March 25th.	1904.	1903.
Length of route...	42	42
Total length of track	81·5	81·5
Number of cars in use	180	—
Car-miles per annum	6,091,437	5,766,100
Passengers carried per annum... ...	60,739 234	57,239,779
Capital expended to date	£1,107,977	£1,039,951
Traffic receipts	£277,665	£261,937
Total receipts	£280,563	£263,057
Working expenses	£154,743	£145,897
Gross profit	£125,820	£117,160
Income per car-mile	11·05d.	10 92d.
Working expenses per car-mile ...	6·09d.	6 05d.
Interest and sinking fund per car-mile	2·15d.	1 69d.
Total expenses per car-mile	8·24d.	7·74d.
Profit or loss per car-mile	2 81d.	3·18d.
Cost of energy per car-mile	·49d.	·50d.
Average fare per passenger	1·09d.	1·10d.
Revenue per mile of route	£6,680	£6,263
Expenditure per mile of route ...	£3,684	£3,474
Total units used (energy obtained from tramways power station)	8,519,868	7,602,981
Units used per car-mile	1·4	1·33
Percentage of working ex'es to receipts	55	55

The total units generated by the Tramways Department amounted to 9,518,680, of which some 998,812 were supplied for street lighting. The total average power costs amounted to ·35d. per unit, or ·52d. per car-mile, and allowing for the street lighting, to ·49d. per car-mile. The estimated additional financial charges (which are included in our profit statement) bring the power costs to ·71d. per unit, or 1·05d. per car-mile—figures which show the wisdom of the department in generating, rather than purchasing, their energy.

From the report we gather that the permanent way has required a great amount of attention during the year, many of the routes having revealed the defects of the earlier methods of construction. Anchoring and welding of the rails, and floating of the rail base with concrete have been introduced very successfully; in all, some 3,000 joints have been welded.

The surplus on the year's working was allocated as follows:—£14,874 to depreciation, £4,212 depreciation on battery stations, &c., and £52,000 in aid of the rates.

The renewals and depreciation fund amounts in all to £85,287.

Profit Statement, 1904.

Interest on loans	£27,292
Sinking fund	27,442
Surplus	71,086
Gross profit	£125,820

Sheffield Corporation Tramways.

The returns of the Sheffield tramways undertaking for the past year show considerable increases in car-mileage and traffic compared with the previous year. This has apparently pulled down the average income per car-mile somewhat, but it is satisfactory to note that this has not adversely affected the average working expenses, which, together with financial charges, are less per car-mile than in the previous year. It will be noted that the department generates its own power at a very economical rate. On the whole, the department has earned a somewhat larger gross profit than in 1903, and on the year's working a surplus of £27,173 remains.

The department is to be congratulated on its promising financial position, a total surplus of £88,244 being available this year, from which we note the renewals fund benefits to the extent of £33,771, the estimated deficiency in the district rate absorbs £7,949, and as in the previous year, linguistical and musical Sheffield benefits by the remainder of the £42,000 voted away; the unabsorbed balance carried forward amounting to £46,223. Mr. A. R. Fearnley is the general manager.

General Statement.

For 12 months ending March 25th.	1904.	1903.
Length of route...	32	30
Total length of track	59	58
Average number of cars in use ...	167·49	143·85
Car-miles run	5,768,231	4,777,146
Passengers carried per annum... ...	61,450,993	54,946,915
Capital expended to date	£1,056,407	£953,572
Traffic receipts	£232,351	£206,729
Total receipts	£235,982	£208,963
Working expenses	£156,403	£129,916
Gross profit	£79,579	£79,047
Income per car-mile	9·818d.	10·49d.
Working expenses per car-mile ...	6·507d.	6·53d.
Interest and sinking fund per car-mile	2·180d.	2·21d.
Total expenses per car-mile	8 687d.	8·74d.
Profit or loss per car-mile	1·131d.	1·75d.
Cost of energy per car-mile	·75d.*	·71d.*
Average fare per passenger	·907d.	·90d.
Revenue per mile of route	£7,374	£6,965
Expenditure per mile of route ...	£4,888	£4,330
Total units used	9,147,302	7,369,539
Units used per car-mile	1·6	1·5
Percentage of working ex'es to receipts	66·27	63

* Energy generated at tramway power station.

Profit Statement, 1904.

Interest on loans	£33,012
Sinking fund, &c.	19,394
Surplus on year's working	27,173
Gross profit	£79,579

CITY NOTES.

Willans & Robinson.

The twenty-first half-yearly report of the directors (for the half-year ended June 30th, 1904), to be submitted at the meeting to be held at Cannon Street Hotel, on Wednesday, October 5th, reads as follows:—

"The directors deeply regret that the results are so unfavourable. Apart from losses at Queen's Ferry, which, under the circumstances, were inevitable, the company's operations at Rugby have, for the first time in its history, resulted in a loss. After making a somewhat increased allowance for depreciation, amounting to £7,601 18s. 11d., there is a loss of £3,345 5s. 9d. in respect of Rugby. The loss at Queen's Ferry, after writing off £9,937 12s. 1d. depreciation, is £25,902 16s. 5d., and there is further a debit balance of £7,932 4s. 9d. brought forward from the preceding half-year. The loss at Rugby is attributable chiefly to the extreme badness of trade, under the stress of which orders are taken by many firms at prices which make profit impossible. As they have before explained, the directors have striven to open up new branches of business, with a growing success upon which they found strong hopes for the future; but such work cannot yield a profit at first, and, in fact, in its initial stages, it is bound to be a source of loss. This affects not only the half-year under consideration, but also the current half-year, and probably the next half-year as well. Nevertheless, the directors are satisfied that, in developing these new branches of work, of which steam turbines and gas engines are the chief, they are taking the surest course for the ultimate revival of the company's prosperity. They are also endeavouring to economise in every way, and have effected large reductions in expenses, though the evidence of this will not be apparent until the accounts of the current half-year are presented. The utmost is being done to maintain the reputation of the company for excellence of manufacture, and to keep the Willans engine in its old position of supremacy. In their efforts to this end the board feels that it is greatly strengthened by the additions made to it last spring.

"It is not possible to operate the Queen's Ferry Works upon a sufficiently large scale to make a profit, or even to pay expenses, without raising more capital for plant and for working. This is out of the question at present, and therefore the works are kept employed only to the extent necessary to complete one important contract. While the works are thus maintained as a going concern (except the steel works, now closed, but capable of being readily

re-started), the directors are endeavouring to find a purchaser for them—subject, of course, to the assent of the trustees for the debenture stockholders. Negotiations to this end are in active progress. The increased loss at Queen's Ferry is largely due to the increase in depreciation (£2,688 more than last half-year). An unexpected source of loss has also arisen in the necessity for rejecting, and valuing only as 'scrap,' a quantity of material made in the earlier stages of the work, and believed, at the time, to be satisfactory. This source of loss is not likely to recur, but under present conditions at Queen's Ferry some loss cannot be avoided, even if the works be closed entirely. Everything that is possible is being done to reduce expenses and to increase efficiency.

"The directors have given constant attention to the improvement of the financial position of the company—which is the dominant factor in the situation. New business, and even the best founded hopes of future profits, will be fruitless unless the company can pay its way and has working capital at command. The directors are glad to say that the financial position during the past few months has much improved. Money has come in comparatively freely from debtors, and shares in other companies (received in part payment under contracts) have been sold at favourable prices. The debt to the Bank has been paid off, and an ample balance created, without selling the whole of the reserve fund investments; investments remain at this date which, at cost, represent £27,053 4s. 6d. The loss upon realising the securities sold, at the present low prices, has been charged against the reserve fund account, which has also been debited with an amount written off from other investments of the company, which the directors have rigorously valued down to what they believe to be thoroughly safe figures. The opinion was expressed at the last meeting that the remuneration of the additional directors should be provided by deductions from the salaries of existing directors. As the directors are remunerated under separate agreements for service, and not collectively, this question, as was explained at the meeting, could only be dealt with by the directors individually, and not by the board as a whole. Mr. Robinson and Sir Gilbert A. Clayton East accepted reductions as from March 31st last, equivalent to their *pro ratâ* proportions of the new directors' salaries. Mr. Arthur Lazenby expressed, and still desires to express, his willingness to follow the same course, but at the wish of some of his colleagues he has deferred action until they could bring the matter, as affecting him, before the shareholders at the ensuing meeting."

Electric Railway and Tramway Carriage Works Co.

Mr. George Richardson presided at the meeting held on September 22nd at Preston. In moving the adoption of the report, he said it was, of course, not satisfactory to have to report a reduced dividend, but he thought that when he explained the reasons the shareholders would think that, under the circumstances, the dividend was fair and satisfactory. They were aware that the trade of the country had not been in as prosperous a condition as heretofore, and this was especially so in connection with their business. There had been a decrease in their output during the year. They had met with serious competition, but two works which had been their greatest competitors had now gone into liquidation, and had been sold. Consequently the shareholders might now look forward to getting better prices than hitherto. For depreciation and general reserve a sum of £19,800 had been set aside. This was a considerable amount taken out of their earnings. Last year the sum carried forward was £5,426, and this year it was reduced to £2,873. With regard to the future, he did not like to prophesy, but the directors thought, from what they could see at present, that they would not have an unsatisfactory balance-sheet to present next year.

The report was adopted.

Dick, Kerr & Co.

Mr. John Kerr, M.P., presided at this company's meeting at Cannon Street Hotel on Tuesday. In moving the adoption of the report (see Electrical Review, September 23rd), he said that while the net profits for the year were only £84,170 17s., as against £110,449 for 1903, they did not feel, in view of the severe competition in all departments, that any apology was necessary. In comparison with the results attained by many other industrial concerns there was reason for congratulation. It had invariably been their custom before arriving at the net profits to make the most ample provision for every possible contingency. Apart from maintaining the works and machinery in the most efficient manner and charging the same to revenue account, he drew attention to the auditors' certificate, where they stated that the plant and machinery had been amply depreciated. The two points he had drawn attention to should always, in his opinion, be well considered in an industrial business. Under Clause 31 of the trust deed it was provided that one-fifth of the net profits were to be set aside as security for the debenture stock until the amount reached £150,000. It had been the aim of the directors to get rid of this obligation at the earliest possible date. It was a source of satisfaction that this aim had been realised within the last five years, and that the liability was now at an end. There could be no doubt that this conservative treatment had been the means of protecting and strengthening the position of the debenture holders and preference shareholders, and the time had now come when the ordinary shareholder would also reap the benefit of this prudent course. He did not wish the shareholders to assume for a moment that in the future the directors might not consider it in the interests of the company to exercise a wise discretion in still adding to their reserve. The amount carried forward this year was £39,922 11s. 4d., against £35,544 18s. 7d. last year. This very large carry forward was a source of strength to the company. In the Far East and in India important contracts had been concluded or were in course of completion. A large piece of work was being carried out in Tokio in the smoothest manner possible, notwithstanding the war. Australia, South Africa, Canada, and Argentina had proved good customers. Europe practically and America completely, by reason of their high protective tariffs, might be accepted as markets which would be of little account. Their peoples meant to retain their own business and encourage home industries—small blame to them—and, at the same time, they had, to them, the inestimable privilege of competing with British manufacturers on equal terms in the British home and Colonial markets. The electrification of the line between Liverpool and Southport on the Lancashire and Yorkshire railway system had been completed, and it was working successfully. This was the largest scheme of railway electrification of a main line so far carried out in this country. There was the possibility of a considerable development of work in this direction in the near future. The experience this company had gained should prove most useful.

Mr. R. H. Prestwich seconded the resolution, which was carried unanimously.

The retiring directors and auditors were re-elected, and a cordial vote of thanks was given to the directors.

South Lancashire Electric Traction and Power Co.

The *Financial Times* says that the report for the year ended June 30th last shows a credit balance of £2,573, making, with £778 brought forward, a total of £3,351. The report states, however, that the liabilities to contractors for works not certified by consulting engineers and the accrued dividends from date of allotment to June 30th last on the preference shares have not been provided for in these accounts, which are also debited with £58,701, being two years' debenture interest. The directors add that, as indicated in the last report, the whole of the tramways and the light railway constituting the first constructional scheme of the company have been in operation since 1903. The receipts on the working of these lines have not quite come up to expectations, but it must be remembered that the districts served by the company's tramways have passed through a crisis. The cotton industry and trade generally have been extremely depressed; moreover, the system still remains to be completed, and there can be no doubt that the sections remaining to be built will not only earn money themselves, but will also largely increase the earning power of the existing lines. The arrangements for raising further capital which were sanctioned by the debenture stockholders at the latter end of last year were actively proceeded with. The efforts of the directors were, however, frustrated, partly by reason of the acute financial depression and partly by the feeling of insecurity arising from the legal proceedings brought against the company and some of the directors by a very small minority of the debenture stockholders. In order to afford more time for negotiations for fresh capital, arrangements had been made for the payment of the debenture interest due on June 30th, but the directors were prevented from carrying them out owing to the attitude adopted by the owners of some of the ordinary shares which were to be transferred. The debenture interest not being paid, the Court, on the application of a debenture stockholder, appointed Mr. J. M. Henderson and Mr. J. R. Salter joint receivers and managers. Negotiations are pending, and there is reason to hope that a reconstruction of capital may be possible, and that the additional capital required to proceed with the construction of the lines may be obtained at a satisfactory rate. An extraordinary general meeting will be held on the 7th prox., for the purpose of considering the advisability of winding up the company voluntarily, and, if thought fit, passing the necessary resolution. Since the last ordinary general meeting Sir John A. Willox, M.P., has, through continued ill-health, retired from the board; Mr. Joseph Beecham and Mr. H. R. Hogg have joined the board.

Mersey Railway Co.

Mr. James Falconer, chairman, presided at Worcester House, E.C., on Tuesday, over the half-yearly ordinary general meeting of the above company, and in moving the adoption of the report, said they had now got to the stage of electrical working, and the only consideration the shareholders had got to deal with was the question of the result of the working. He was glad to say that the accounts for the half-year showed a substantial improvement, for the receipts had been increased and the cost of working decreased. They were not, however, satisfied that they had reached a final conclusion, and they looked forward in the future to increasing the receipts, as the public realised the advantages which the present system of working provided for them, and as the traffic in the district extended and developed; they also looked forward to improvement as regarded the cost of working, but were keeping a continual watch on every item of expenditure, and economising as far as they possibly could consistently with efficiency. Taking the revenue account, he felt that the figures were gratifying. The number of passengers carried, including season ticket-holders, during the half-year was about 4,500,000, as against 3,200,000 in the corresponding half of 1903; which was an increase of something like 40 per cent. The receipts, excluding season tickets, were £33,715, as against £26,136. The number of season ticket-holders had increased from 1,749 to 2,884. The total receipts for the half-year had been £40,914, against £32,278, which was almost an increase of 25 per cent. The total working expenses for the half-year were £33,591, as

against £32,061, but if they excluded the exceptional charges, of pumping and ventilation, the working expenses were £29,751, as against £27,375. In measuring, however, the effect of the change from steam traction to electricity, they had to take into account the fact that they had greatly increased the service to the public, and were doing practically double the work. In the half-year with which they were dealing, the train mileage was 411,683, as against a train mileage in the corresponding half of 1903 of 218,308. If they wished to compare the cost of working the electrical service as against the cost of working a steam service on the Mersey railway, the proper comparison was between the cost per train-mile of the two classes of working. Looked at from that point, the figures were very striking. Excluding pumping and ventilation, the cost per train-mile during the half-year ending June 30th, 1903, which was four months steam and two months electricity, was 30·1d. The cost during the half-year under review was 17·35d. per train-mile —a reduction equal to about 42 per cent. If they included exceptional charges, the cost per train-mile in the first half of 1903 was 35·25d., whilst last half-year it was 19·58d. Those figures conclusively showed to his mind, as they would, he felt, show to the minds of everyone, the extraordinary superiority of electrical traction over steam traction in dealing with such a railway as theirs. But it had further to be borne in mind that this cost per train-mile represented a cost for which they could carry practically double the traffic which was being carried at the present time. They had now demonstrated that at a cost of 19½d. per train-mile they could carry any number of passengers who were likely to come, and they had reached the point of earning from all sources something like 2s. per train-mile. To his mind the future of the company depended on their being able to increase that figure of 2s., and the board were doing everything they possibly could, by providing travelling facilities for the public, to increase it, and they could only await the development of the very important district on the Cheshire side of the Mersey. They were glad to state that since they last met they had entered into an arrangement with the contractors which had resulted in a settlement of their differences. They were both interested in the prosperity of the company, and it was satisfactory that they were working together for its development. A holder of redeemable stock had written to ask when the stock would be redeemed. The period fixed for the redemption was August 12th, 1905, and under the arrangement which had been made with the contractors, the money required would be provided, and the Westinghouse Co. had also undertaken after the date to guarantee the interest on the perpetual debenture stock which would take its place.

Mr. S. G. Sheppard seconded the motion.

Relying to a number of questions asked, the Chairman said there was a feeling in Liverpool that the first-class should be retained, and it paid them to run first-class as well as third. The exceptional charges for pumping and ventilation were not exceptional from an accountant's point of view, for they would continue, although it was hoped that the cost might be reduced. If the existing traffic were doubled, it would mean practically doubling their receipts, and if this were done it would mean about £30,000 to be divided amongst the ordinary shareholders. As to whether that could be done or not, was a delicate question to answer, and the board could only do everything in their power by giving the public facilities to attract them to the line.

The report was then adopted.

Ferranti, Ltd., Reconstruction.—The scheme outlined on p. 509 of our last issue, came before the meetings yesterday. It was adopted by the unsecured creditors, the preference shareholders and debenture-holders. The new company will continue only the meter and switch departments, the engine and alternator departments having been closed down.

Swansea Improvements and Tramways Co.—The report for the half-year ended June 30th states that the gross earnings amounted to £13,835, an increase of £848. After deducting working expenses, debenture and other interest, there was a net profit of £3,935, which, with the balance from the previous half-year, makes an available total of £5,072. It is recommended that £1,000 be transferred to reserve in reduction of the amount due to the British Electric Traction Co., and that the usual dividends be paid on the two classes of preference shares, leaving £2,773 to be carried forward.

Eastern Extension, Australasia & China Telegraph Co.—The directors have declared a dividend for the quarter ended June 30th last of 2s. 6d. per share.

Evered & Co.—The directors have declared an interim dividend at the rate of 7½ per cent. per annum for the half-year ended June 30th. Last year's interim dividend was at the same rate.

Folkestone Electricity Supply Co.—The directors have declared an interim dividend at the rate of 4 per cent. per annum in respect of the half-year ended June 30th last on the ordinary shares. This is at the same rate as last year's interim announcement.

Eastern Telegraph Co., Ltd.—The directors announce the payment on October 15th of a dividend at the rate of 1¼ per cent. on the ordinary stock, tax free, in respect of the quarter ended June 30th.

STOCKS AND SHARES.

Wednesday Evening.

More business has come about the Stock Exchange since we were last writing, and the investment sections receive considerably the largest part of it. Consols continue dull, but the Railway market has taken a new lease of vitality and of better prices, although the improvement is slow in spreading to the electrical railway companies. Electricity Supply shares are also somewhat colourless, the demand in this department being mainly confined to the Debenture stocks. Telegraph issues are fairly firm, and Telephones show a slight disposition to easier prices.

At length District Ordinary has risen over 40 again, the price showing a 2 point rise at 40½. Statements which do not seem entirely guileless of inspiration are being circulated in regard to the early prospect of the electrification being completed and the benefits expected to accrue to the company thereby. A good tone is apparent in Metropolitan Consolidated stock; the price has advanced a couple of points to 96½, and the Surplus Lands stock is nearly 3 better at 75½. Another 2 per cent. improvement lifted City and South London to 49, the rise having been remarkably sharp, and almost unchecked, since it started from 39 quite recently. Tuesday's meeting had no more effect upon Mersey stock than the issue of the satisfactory report set out in these columns last week, and the price remains about 7½. Great Northern and City Preferred shares are 5¼, and no alteration has occurred in the Central London Railway descriptions.

To record a rise in Anglo-Argentine Tramway shares becomes almost monotonous, so regularly has it to be done. The Ordinary at 6⅝ are ⅛ up, the Preference keeping at 5½, and the Debenture stock about 140½. City of Buenos Ayres Debenture is a couple of points higher than this, although both stocks carry 6 per cent. interest payable on the same dates. To buy either security is, however, a matter of much difficulty. Calcutta Trams display strength at 7¾, and there is a little business doing in London United Preference, which are 10⅞ middle, the Debenture stock being quoted 104. British Electric Tractions retain their last week's rise, but there is not much trade doing in the Ordinary. The Preference have been sought after, and, at 11, mark a gain of 5s.

Falls of £1 a share each in Willans & Robinson Ordinary and Preference reflect the sharp disappointment felt at the nature of the report published this week. A loss of £29,200 for the first six months of the current year was most unexpected. The Ordinary and Preference shares go dividendless, and, of course, the reserve and carry forward get nothing. Such a showing has brought the price of the Ordinary to 1½, and the Preference to 2½, although the Debenture stock is left in the *Official List* at 75 to 80. To deal at the top figure would be easy enough, but what price the holder might have to accept, if he wanted to sell, is a very different matter. There is no change in Babcock & Wilcox Ordinary at 3¼, nor in the Preference at 1⅝. Telegraph Constructions put on £1 at 36½; it was hinted last week that the shares might be expected to participate in the firmness shown by the telegraph market.

Investors who are content to wait for a year or two before obtaining interest on their capital may follow the fortunes of the South Wales Electrical Power Distribution Co. with advantage. The concern was floated in May, 1902, and the number of consumers is now increasing at a rate considerably beyond the directors' anticipations. By next year it is likely that the company will be in a position to pay 4 per cent.; after that its progress in dividend distribution should be rapid. The investment, of course, is a lock-up, but in view of the field ahead of the company and of the way in which customers are already sending orders, it is reasonable to suppose that not many years will be required to see it firmly established in a position that would make minimum 10 per cent. dividends a matter of assurance. The price of the shares is about 8¼, a discount of 35s. upon the par value of £10.

Telegraph issues, as already noticed, have attracted buyers principally to their prior-charge stocks. Profit-taking lowered Anglo-American Deferred to 8¼, at which the price "made-up" last Tuesday. Indo-Europeans are £1 harder at 45½, and investment demand has raised Eastern Telegraph Ordinary a point to 131½. China shares have not moved from 12½, and the Trust varieties continue quiet. French buying put Great Northerns ½ better to 29½. The only change in Telephone stocks is a point decline in National Deferred, which reduces it to 92.

Westminsters, in the Electricity Supply division, have an improvement to show of 10s., and Edmundson's Ordinary are ½ harder at 6¼. Metropolitans fell ¼ to 16. A few of the Debenture stocks are better, notably Chelsea 4½ per cent. at 109½, the rise being 2 points. Half that amount has been scored by London Electric Debenture at 98½, while Metropolitan 4½ per cent. stock is also 1 up at 113½. The quotation for Smithfield Debenture has been narrowed a shade in favour of the buyer. Bromley (Kent) shares are ¼ down at 5½, but Folkestone Debenture at 101½ has risen a point.

Calcutta Tramways Co.—The directors have declared an interim dividend of 3s. per share (being at the rate of 6 per cent. per annum) on account of the half-year to June 30th.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations Sept. 21st.	Closing Quotations Sept. 28th	Business done week ended Sept. 28th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2½— 3½	2½— 3½	..	..
119,700‡	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	.. — ..	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	50 — 53	50 — 53	51	50¼
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	96 — 98	96 — 98	97⅞	96⅝
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	8½— 8¾	8 — 8¼	8 7/16	8 1/16
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	7 %	5 — 5½	5 — 5½	..	..
18,888,800§	Commercial Cable	$100	8 %	8 %	..	170 —190	170 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	94 — 96	94 — 97	96½	..
16,000	Cuba Telegraph	10	4 %	6¼%	5 %	7 — 8	7 — 8	..	..
6,000	Do. 10 % Pref.	10	..	..	..	15 — 16	15 — 16	..	..
6,000	Direct Spanish Telegraph 10 % Cum. Pref.	5	..	..	..	7 — 8	7 — 8	..	..
80,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101 %	98 —101%	..	..
60,710‡	Direct United States Cable	20	8½%	8½%	3 %	10½— 10¾	10½— 10¾	10½	..
81,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,900, Red.	100	..	..	..	99 —101	99 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	7 %	128 —133	129 —134	133½	131
1,955,565	Do. 8½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	88½	88
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	108	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	12¼— 12¾	12¼— 12¾	12⅝	12⅜
820,000‡	Do. 4 % Deb. Stock	Stock	..	..	..	105 —108	105 —108	..	..
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	99 —102	99 —102	100½	100
200,000‡	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	100 —103 %	100 —103 %	..	..
180,227	Globe Telegraph and Trust	10	5½%	£3 16 7*	5½%	9½— 9¾	9½— 9¾	9 7/16	9⅜
180,042	Do. do. 6 % Pref.	10	..	..	..	13½— 14¼	13½— 14¼	14	13⅝
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	15 %	28½— 29½	29 — 30	28½	..
54,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	99 —101	99 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	10 %	43 — 46	44 — 47	46	45½
72,680	Monte Video Telephone Co., Ltd., Ord.	1	..	..	..	7/16 — 9/16	7/16 — 9/16	..	..
1,988,888	National Telephone, Pref. Stock	100	5 %	6 %	6 %	104 —106	104 —106	105½	104½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	92 — 94	91 — 93	92½	91½
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12 — 14	12 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	11 — 13	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5⅝	5½— 5⅝	5½	..
000,000‡	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	97 — 99	97 — 99	97⅛	..
689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	104 —106	104 —106	105	104½
1,000,000	Do. do. Prov. Certs., 35 % to be paid	..	..	..	..	67 — 69	67 — 69	..	..
179,318	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	6¼%	1/16— 1/16	1/16— 1/16	1	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1/16— 1/16	1/16— 1/16	..	..
100,000‡	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	5 %	..	6¾— 7¼	6¾— 7¼	..	..
5,808	Submarine Cables Trust	Certs.	..	..	..	118 —123	118 —123	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	6 — 6¼	6 — 6¼	6¼	6⅛
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
179,947‡	Do. do. 5 % Debs.	Stock	..	..	..	103 —106	103 —106	..	..
15,600	West African Telegraph, Shares	10	..	2 %	4 %	6 — 7	6 — 7	..	..
30,008	West Coast of America, 1 to 30,000 and 53,001 to 53,008	2½	..	..	..	1/16— 3/16	1/16— 3/16	..	..
150,000‡	West Coast of America, 4% Debs., 1 to 1,500 guar. by Brax. Sub. Tel.	100	..	..	..	97 — 100	97 —100	..	..
207,280	Western Telegraph, Ltd., Nos. 1 to 207,280	10	7 %	7 %	7 %	12½— 12¾	12½— 12¾	12⅝	12⅜
75,000‡	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	101 —104	101 —104	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	101 —104	101 —104	..	..
88,821	West India and Panama Telegraph	10	..	..	..	⅜— ½	⅜— ½	..	..
54,568	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6½— 7	6½— 7	6¾	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	5 — 6	5 — 6	..	..
80,000‡	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	..	..	..	100 —103	100 —103	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	5 — 6	5 — 6	5 1/16	5 1/32
10,000	Do. do. "A" 6 % Cum. Pref.	10	..	..	..	8½— 9½	8¼— 9¼	..	..
800,000‡	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	92 — 97	92 — 97	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9¼— 10	9¼— 10	9 7/8	9 3/4
100,000	Do. do 6 % Cum. Pref.	10	..	..	..	10¾— 11	10¾— 11¼	11	10 13/16
600,000‡	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	117 —119	117 —120	118½	..
	Do. do. 4½% 2nd Deb. Stock Red.	100	..	..	..	94 — 97	94 — 97	..	..
100,000	British Insulated and Helsby Cables	5	10 %	10 %	8 %	5¾— 6 xd	5¾— 6	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5¾— 6	5¾— 6	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	101 —104	101 —104	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	1/16— 1/16	1/16— 1/16	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,731	Brush Electrical Engineering, Ord., 1 to 105,731	2	Nil	Nil	Nil	½— ¾	½— ¾	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	6 %	1 — 1½	1 — 1½	..	..
125,000‡	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	94 — 97	94 — 97	..	..
25,000‡	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	70 — 75	70 — 75	..	..
85,000	Callender's Cable Construction shares	5	20 %	15 %	12½%	9½— 10½	9½— 10¾	..	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
90,000‡	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	101 —105	101 —105	104	103¾
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	85 — 87	85 — 87	87	86
494,093	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	100 —102	100 —102	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	79 — 81	79 — 81	80¾	80¼
1,330,000	City and South London Railway	Stock	2 %	3½%	2⅝%	46 — 48	48 — 50	49¼	47½
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	5 %	..	1½— 2	1½— 2	1½	..
100,000‡	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	90 — 95	90 — 95	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	½— ¾	½— ¾	13/16	..
17,189	Do. do. "A" shares, 01—017,189	5	Nil	Nil	..	1 — 2	1 — 2	..	..
44,028‡	Do. do. 4 % Deb. Stock Red.	100	..	..	..	77 — 82	77 — 82	..	..
100,000‡	Do. do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	..	..	..	79 — 83	79 — 83	..	..
112,100	Electric Construction 1 to 112,100	2	6 %	6 %	4 %	1 — 1½	1 — 1½	..	..
31,890	Do. do. 7 % Cum. Pref., 1 to 31,890	2	..	..	..	2 — 2½	2 — 2½	..	..
82,500‡	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	96 — 99	96 — 99	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9 — 9½	9 — 9½	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	93 — 98	93 — 98	..	..
200,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	10½— 11½xd	10½— 11½	..	..
200,000	Do. do. 4½ % Pref.	5	..	..	..	5 — 5½	5 — 5½	..	..
45,900	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	107 —111	107 —111	..	..
50,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18¼— 19½	18¼— 19½	19 1/16	19
800,000‡	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	99 —102 xd	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	3⅜— 3⅝	3⅜— 3⅝	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	10 — 10½	10 — 10½	..	..
87,350	Telegraph Construction and Maintenance	12	20 %	20 %	20 %	34 — 37	35 — 38	36½	35½
150,000‡	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000‡	Waterloo & City Railway, Ord. Stock	100	3 %	3¼%	3½%	86 — 89	86 — 89	..	..

* A period of nine months. † Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 3 per cent. (April 21st 1904).

SHARE LIST OF ELECTRICAL COMPANIES (continued).—ELECTRICITY SUPPLY COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations Sept. 21st.	Closing Quotations Sept. 28th.	Business done week ended Sept. 28th, 1904. Highest.	Lowest.
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	‡ 5	8%	8 %	10 %	10⅞ — 11⅛	10⅞ — 11⅛	..	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	10⅞ — 10⅞	10⅞ — 10⅞	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	107 —110	107 —110	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	8 — 8⅛	8 — 8⅛	8 1/16	8
70,000	Do. do. 4½% Cum. Pref. ..	5	..	..	..	5⅛ — 5⅜	5⅛ — 5⅜	5 7/16	5 5/16
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4⅜ — 5	4⅜ — 5	4⅜	..
40,000	Do. do. 1903	5	..	..	..	4⅜ — 5	4⅜ — 5	4 15/16	4⅜
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	102 —104	103½	101½
44,436	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5⅛%	6¾ — 7 xd	6¾ — 7	6⅞	6 1/16
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	108 —111	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10¼ — 10⅜	10¼ — 10⅜	10⅜	..
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	..	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	120 —125	120 —125	123½	..
800,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	102 —105	102 —105	..	..
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4 %	4 %	8 — 9	8 — 9	8⅝	8⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11½ — 12	11½ — 12	11⅝	11⅜
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	105 —108	105 —108	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	101 —104	101 —104	..	..
50,000	Edmundson's Electricity Corporation, Ord. Shares	5	7 %	7 %	7 %	6 — 6⅛	6⅛ — 6⅜	6⅜	6 5/16
80,000	Do. do. 6 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6 5/16	6⅛
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	105 —108	105 —108	..	..
21,000	Kensington and Knightsbridge Electric Ord.	5	10 %	10 %	12%	12 — 13	12 — 13	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	102 —105	102 —105	..	..
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1⅜ — 2⅛	1⅜ — 2⅛	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	5 — 5⅛	5 — 5⅛	5 1/16	..
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	97 —100	98⅛	98½
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6⅔%	7½%	8⅓%	16 — 16½	15⅞ — 16⅛	16⅛	15 15/16
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5⅜ — 5⅝	5⅜ — 5⅝	5 1/16	5 1/16
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	110 —115	111 —116	..	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	96 — 99	96 — 99	98½	..
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	14½ — 15½	14½ — 15½	..	..
59,000	Do. do. 4% 1st Mort. Deb.	100	..	..	..	100— 103	100— 103	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14½ — 15½	14½ — 15½	14⅝	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	2⅜ — 3⅛	2⅜ — 3⅛	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	83 — 88	83 — 87	..	..
65,000	South London Electricity Supply, Ord.	5	..	1¾%	3 %	4⅛ — 4⅜	4⅛ — 4⅜	4 1/16	4 1/16
100,000	South Metropolitan Electric Light and Power, Ord.	1	..	..	..	⅞ — 1	⅞ — 1	⅞	..
50,000	Do. 7 % Pref.	1	..	..	..	1⅛ — 1⅛	1⅛ — 1⅛	..	..
100,000	Do. 4½% 1st Deb. Stock	100	..	..	..	105 —109	105 —109	..	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	5	4⅛
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4⅜ — 5⅛	4⅜ — 5⅛	5	4⅛
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12 — 13	12⅜ — 13⅛	13 1/16	12⅛
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6⅛	6 — 6⅛	6 1/16	6⅛

* Subject to Founders Shares. ‡ Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, September 28th

CHEMICALS, &c.

		Latest Price.	Week's Inc. or Dec.
a Acid, Hydrochloric	per cwt.	5/-	..
a ,, Nitric	per cwt.	22/-	..
a ,, Oxalic	per cwt.	32/-	..
a ,, Sulphuric	per cwt.	5/6	..
a Ammoniac, Sal	per cwt.	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a ,, ,, ...	per ton	£30	..
a Bleaching powder	per ton	£4 10	..
a Bisulphide of Carbon ..	per ton	£15	..
a Borax	per ton	£18	..
a Benzole (90 %)	per gal.	7/-	..
a ,, (50/90 %)	per gal.	5/6	..
a Copper Sulphate	per ton	£19	..
a Lead, Nitrate	per ton	£30	..
a ,, White Sugar	per ton	£31	..
a ,, Peroxide	per ton	£27 10	..
a Methylated Spirit	per gal.	2/6	..
a Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8d.	..
a ,, Caustic (75/80%).. ..	per ton	£24	..
a Shellac	per cwt.	210/-	..
a Sulphate of Magnesia ..	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a ,, Recovered	per ton	£5 10	..
a ,, Lump	per ton	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a ,, Crystals	per ton	£8	..
a ,, Bichromate, casks.. ..	per lb.	2½d.	..

METALS, &c.

		Latest Price.	Week's Inc. or Dec.
b Aluminium Ingots, in ton lots ..	per ton	£130	..
b ,, Wire, in ton lots ..	per ton	£168	..
b ,, Sheet, in ton lots ..	per ton	£166	..
b Babbitt's metal ingots	per ton	£48 to £130	..
c Brass (rolled metal 2" to 12") basis	per lb.	6¾d.	..
c ,, Tube (brazed)	per lb.	8¼d.	..
c ,, ,, (solid drawn).. ..	per lb.	7¼d.	..
c ,, Wire, basis..	per lb.	6¾d.	..
c Copper Tubes (brazed)	per lb.	9d.	..
c ,, ,, (solid drawn) ..	per lb.	9¼d.	..
c Copper Bars (best selected ..	per ton	£71	..

METALS, &c. (continued).

		Latest Price.	Week's Dec. or Inc.
g Copper Sheet	per ton	£71	..
g ,, Rod	per ton	£71	..
e ,, (Electrolytic) Bars ..	per ton	£62	..
e ,, ,, Sheets ..	per ton	£78	..
e ,, ,, Rod ..	per ton	£72	..
e ,, ,, H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	per lb.	3/8	..
f ,, Sheet	per lb.	3/-	..
n German Silver Wire	per lb.	1/6	..
h Gutta-percha fine	per lb.	8/-	..
h India-rubber, Para fine	per lb.	4/8 to 4/9	..
i Iron, Charcoal Sheets	per ton	£18	..
i ,, Pig (Cleveland warrants)	per ton	43/1½	..
i ,, Forgings, according to size	per ton	From £11	..
i ,, Scrap, heavy	per ton	47/6 to 50/-	..
i ,, Wire, galvanised No. 8 ..	per ton	£9 15	..
g Lead, English Ingot	per ton	£12 5	2/6 dec.
g ,, ,, Sheet	per ton	£11 17s. 6d.	..
m Manganin Wire No. 28	per lb.	8/-	..
g Mercury	per bot.	£7 15	..
d Mica (in original cases) small ..	per lb.	6d. to 1/	..
d ,, ,, ,, medium	per lb.	2/6 to 4/-	..
d ,, ,, ,, large ..	per lb.	4/6 to 8/6	..
p Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p ,, rolled bars & rods	per lb.	1/- to 1/6	..
p ,, ,, strip & sheet	per lb.	From 1/1	..
o Platinum	per oz.	£4	..
e Silicium Bronze Wire	per lb.	9d. to 11d.	..
i Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i ,, ,, in bars		£15 to £40	..
g Tin, Block	per ton	£129 10 to £130 10	£1 inc.
g ,, Foil	per lb.	1/6	..
n ,, Wire, Nos. 1 to 16	per lb.	1/7½	½d. inc.
p White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j ,, 6 lea. Flax	per lb.	6¾d.	..
j ,, 3 ply 10 lbs. Russian ..	per lb.	4½d.	..
j ,, 10 lbs. Russian, single ..	per lb.	4½d.	..
j ,, 180 lbs. Jute rove ..	per ton	£11	..
k Zinc, Sh'ts (Vieille Montagne brd.)	per ton	£25 15	..

a Quotations supplied by Messrs.—a G. Boot & Co.; b The British Aluminium Co., Ltd.; c Thos. Bolton & Sons., Ltd.; d F. Wiggins & Sons.; e Frederick Smith & Co., f India-Rubber, G.P. and Teleg. Works Co., Ltd.; g James & Shakspeare; h Edward Till & Co.; i Bolling & Lowe; j Walter H. Hindley and Co., Ltd.; k Morris Ashby, Ltd.; m W. T. Glover & Co., Ltd.; n P. Ormiston & Sons; o Johnson, Matthey & Co., Ltd.; p The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Aberdeen	Sep. 24	1,451	+203	17	27,518	+ 5,094	10	—
Bath	,, 21	805	—	89	24,643	—	12½	—
Birmingham ..	,, 24	5,396	—293	39	209,220	+11,475	8½	—
Blackburn	,, 23	1,014	+165	24	25,570	+ 2,514	13½	—
Blackpool	,, 22	1,760	+266	25	86,701	+ 5,101	8½	—
,, —Fleetw'd	,, 24	986	+ 81	13	17,390	+ 177	7½	—
,, —Lytham	,, 22	698	+ 81	47	18,867	+ 7,114	7½	—
Bolton	,, 25	1,860	+ 14	26	49,380	+ 4.8	25	—
Bournemouth ..	,, 21	1,311	+118	25	30,633	—	10½	—
Bradford	,, 17	4,864	+1053	24	116,208	+20,917	50	—
Brighton	,, 25	1,962	+ 72	—	28,630	—	9	—
Bristol	,, 23	5,172	+ 21	—	—	—	28	—
c Devonport ..	,, 16	575	+ 41	37	20,116	+ 3,998	5	—
c Dudley—Sto'rb'ge	,, 16	942	+ 69	37	32,702	+ 1,353	18½	—
c Gateshead ..	,, 16	924	+ 35	37	33,682	+ 1,464	10½	+ ½
c Gr'n'k—Pt. Glsgw	,, 16	720	+ 28	37	21,957	+ 1,142	7½	—
c Oldham—Ashton	,, 16	562	+ 6	37	20,585	— 880	8	—
c Potteries	,, 16	1,804	+125	37	63,172	+ 5,188	28½	—
c South Staffs. ..	,, 16	719	—242	37	28,549	— 4,807	21½	— ½
c Swansea	,, 16	545	+ 4	37	20,572	+ 1,012	5½	—
c Wolverhampton..	,, 16	394	— 41	37	14,622	— 84	10½	+8
c Yorks. Wool Dist.	,, 16	587	+1 0	37	22,334	+ 8,580	6	—
c Miscellaneous ..	,, 16	3,755	—	37	124,301	—	—	—
Burnley	,, 24	1,058	+105	—	—	—	10½	+2½
Burton-on-Trent ..	,, 18	369	— 42	24½	9,095	—	8½	—
Cardiff	Aug. 20	2,189	+101	20	43,465	+ 1,376	14	—
Chatham & District	Sep. 22	641	+ 24	38	22,720	+ 2,208	8·84	—
Cork	,, 22	519	— 34	38	18,010	— 2,360	9·89	—
Dover	,, 24	286	— 18	38	8,571	— 271	8	—

Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
Dublin	Sep. 23	5,060	— 24	—	67,222	— 3,027	47	+ ½
East Ham	,, 24	707	— 21	25	19,619	+ 1,409	6½	—
Glasgow	,, 24	15,247	+ 618	17	241,398	+14,806	71½	+5½
Halifax (2 weeks) ..	,, 21	3,162	+ 347	25	40,175	+ 3,381	33	+1½
Huddersfield ..	,, 24	1,299	— 332	25	35,226	+ 2,427	28	—
Hull	,, 24	2,111	+199	25	55,220	+ 7,511	13	+2½
Ilkeston	,, 21	147	— 36	25	3,787	—	3·5	—
Ipswich	,, 24	507	—	25	13,818	—	10½	—
Isle of Thanet ..	,, 24	847	— 15	38	30,194	+ 1,533	10½	—
Leeds	,, 24	5,845	+ 89	25	155,803	+10,145	81½	+2
Liverpool	,, 17	10,646	+206	38	394,119	+12,502	108	—
London C. C. ..	,, 17	18,907	+3493	24	311,866	+65,027	47½	+7½
Manchester	,, 27	12,885	+ 75	25	314,977	+12,887	137½	+12½
Newcastle	,, 24	3,539	— 59	—	—	—	17	—
Portsmouth	,, 24	1,948	— 3	—	55,981	+ 4,757	14½	—
Salford	,, 19	4,286	+198	24	102,562	+ 7,286	30	—
Sheffield	,, 18	4,744	+171	25	119,438	+ 9,122	84½	+2½
Southampton	,, 22	1,048	— 47	25	26,317	— 1,711	9	—
Southend-on-Sea ..	,, 21	443	+ 59	25	10,929	+ 1,206	6½	—
Sunderland	,, 18	1,374	+560	25	32,948	+ 866	21	+1
Tyneside	,, 21	442	— 92	38	14,912	+ 2,399	8·9	+·4
West Ham	,, 22	1,141	—	30	27,26s	—	8·62	—
Wolverhampton ..	,, 21	708	+337	—	—	—	9·5	—
Cen. London Rly. ..	,, 24	6,397	+309	12	70,547	— 1,118	6	—
City & S. Lon. Rly.	,, 25	2,673	+ 21	13	30,936	— 1,108	6½	—
Dublin—Lucan Rly.	,, 23	141	+ 9	12	1,767	— 4	6½	—
G. N. and City Ry.	,, 24	1,108	+ 28	32	30,636	—	3½	—
L'pool Overh'd Rly.	,, 25	1,529	—180	13	21,574	— 731	6½	+4½
Mersey Railway ..	,, 24	1,414	+ 78	12	17,272	+ 1,945	4½	—

* Compared with the corresponding period of 1903.

BUSINESS AND BANKRUPTCY.

[The twenty-first general annual report by the Board of Trade under Section 131 of the Bankruptcy Act, 1883.]

Considering the unsatisfactory condition of business generally, there is reason for comparative satisfaction in learning from the report that the number of receiving orders, and orders of administration under Sec. 125, so far as relates to electricians and electrical engineers, increased by only one. In 1902 there were 12, in 1903 there were 13. This is the only statistical table in which electricians and electrical engineers are specified. The total failures under Bankruptcy and Deeds of Arrangement Acts in principal trades shows the failures in the metal trades to have increased from 334 in 1902 to 368 in 1903. From the analysis of these trades for 1903, it is observed that engineers and founders are responsible for 59, metal brokers and merchants 13, ironmongers 74, iron and hardware dealers 23, miscellaneous metal ware dealers 62, miscellaneous metal workers 103, and blacksmiths and farriers 34. No doubt many of these trades are, in a degree, more or less remotely interested in electrical manufactures or trade.

The report of the Inspector-General contains many points of interest. Under the Bankruptcy Acts, 1883 and 1890, there were, during 1903, 4,286 receiving orders with liabilities estimated at £5,320,967, and assets estimated at £2,535,432. Taking the costs of, and loss on, realisation at an average of 66⅔ per cent. of the assets as explained in the report for 1898, the estimated loss to creditors for 1903 is £4,472,036.

Under the Deeds of Arrangement Act, 1887, there were, for 1903, 3,622 deeds with liabilities estimated at £4,354,315, and assets estimated at £2,505,669. The estimated loss to creditors on the basis of 40 per cent. of the assets for costs of, and loss on realisation, is £2,850,914.

Thus the total estimated loss for the year is £7,322,950.

"Although the total number of cases in 1903 was somewhat larger than in 1902, there has again been a decrease in the number of receiving orders in which the unsecured liabilities were £20,000 and upwards, viz., from 30 with liabilities of £1,552,400 in 1902 to 26 with liabilities of £1,367,300 in 1903.

It will be observed that the financial and speculative failures show a substantial decline in number, though the average liabilities in such cases are larger. In this class a large proportion of the aggregate liabilities has accrued in connection with unsuccessful land and building speculations extending over a considerable period of time. The ordinary trade failures show an increase, both in number and liabilities."

There has been a large increase in the number of cases in which it has been necessary to remove trustees, principally on the ground of misconduct.

Attention is called to the difficulties in which creditors are placed when the partnership name differs wholly from the name of the individuals composing the firm, and there are cases in which a partnership name is deliberately adopted for purposes of concealment or evasion.

In these days of anxiety for business, attention may be profitably drawn to the following paragraph in the report:—

It is noteworthy, as bearing on the singular trustfulness of creditors, that H.M. Consul-General at Naples, in his report on the trade of South Italy for the year 1903, after referring to the heavy costs attending bankruptcy proceedings in that country, remarks upon instances of goods being sent by British traders without exacting any deposit, and apparently even without inquiry, to firms ordering. He mentions that there were cases during the past year of British firms being victimised by a firm which had no "real" existence, yet obtained goods on credit, selling them for what they would fetch, and when at last the culprits were hunted down it was found that they had neither goods nor money.

The report by the solicitor contains much interesting evidence of the care exercised in protecting creditors' interests, but we can only summarise one instance where one creditor had protected himself to the prejudice of the others. Though supported by the County Court Judge, the decision was reversed on appeal. The bankrupt was a farmer, and purchased some cows fron his father-in-law. The latter, when he found he could not obtain payment, selected some of the cows, and drove them off to his own premises, notwithstanding the objections of the purchaser. Shortly afterwards the receiving order was made, at which time the animals were in the father-in-law's possession. The Divisional Court held that the taking of the bankrupt's cattle against his will was, in effect, a trespass, and gave the father-in-law no property in them. He was, therefore, ordered to pay their value to the Official Receiver. If the decision of the County Court Judge had been upheld, it would not have been a difficult matter for a creditor, especially one connected by family ties with a debtor, to succeed in obtaining a fraudulent preference over the general body of creditors.

But whilst the law has thus been shown to afford protection against such preferences, it would seem that some alteration is required in a bankruptcy system which permits insolvents to live handsomely at other people's expense. The Inspector-General's report says:—

A marked feature in several of the large cases, and one which is doubtless characteristic of a considerable proportion of the smaller trading failures, is the excessive amount of drawings for personal and household expenses. Little regard is had to whether profits or losses are made; the debtor considers himself entitled to live handsomely on his business so long as it can be kept going, and ultimately his extravagant withdrawals go to swell the deficiency of his assets to meet his unsecured liabilities. Thus a firm of bill brokers who since 1891 incurred losses by bad debts to the extent of £16 000, overdrew their profits during the same period by £15,758; a leather merchant and boot factor who, during the three years preceding his failure, lost £21,000 on trading and in bad debts, drew more than £2,000 a year for household and personal expenses; a textile merchant who in 14 years made £7,489 net profit, withdrew £18,921; a firm of timber merchants (two partners), who made profits of £29,103 in 15 years, withdrew £54,021; two Austrian Jews, who commenced business as rubber merchants in 1894 *without capital*, drew from the business in nine years £28,000; they then failed, and creditors for £97,000 found that the assets to meet their claims were only worth about £7,000.

These cases show that the parasites on trade very well realise the careless soundings of some business people. Not the substance, but the appearance of prosperity, too often controls credit. The honest debtor who curtails his expenses when things are going wrong impairs his credit. The dishonest debtor increases his expenses, and by appearances improves his credit. Traders should learn some useful lessons from these facts.

TREATING INCANDESCENT LAMP FILAMENTS.

Under the above title, Mr. R. McNeill has an article in the *Electrical World and Engineer*, New York, for September 3rd, 1904. The general principle of the "treating" or "flashing" process, the heating to incandescence of carbon filaments in hydrocarbon gas or vapour, so much better expressed by the French word "carburation," is well understood by all electricians. In the article in question, however, Mr. McNeill gives a comprehensive sketch of the process and apparatus in daily use in the States and in other countries. As technical details of processes relating to the manufacture of incandescent lamps, and to many other manufactures for that matter, rarely find their way into print, some of our readers may be interested in perusing the appended quotation, which deals broadly with the apparatus employed. Those conversant with the details of lamp manufacture will not, however, learn very much from it, since the apparatus, so far as it is described, will be substantially familiar to them, whilst in constructive and experimental data the information given is meagre.

Mr. McNeill leads up to the description of the apparatus with some brief remarks on the preparation and character of filaments, as employed in the States. The process of making the thread for filaments is the same as that in operation everywhere else—the preparation of a solution of cellulose in a concentrated solution of zinc chloride, the projection of the compound solution through a die into methylated spirit, and the subsequent washing and drying of the resulting thread. The carbonisation of the thread is as practised all over the world. The filaments "are all carefully graded according to diameter, the usual variation allowable being one-eighth

of a thousand each way," thus indicating that the manufacturers "out West" have not been able, any more than those in Europe, to exactly regulate the diameter of the uncarbonised thread. After enumerating some of the principal advantages derived from the treating process, it is stated to be the practice to reduce the resistance of the filament, so that it is, when cold, approximately one-half the original, though a good deal of latitude in this respect is permissible. In dealing with several of the advantages attributed to the treating process, some, but by no means all, of the explanations, or rather assertions made, are a little imaginative or inconclusive. Thus, after stating that by means of the process the filament is raised to a much higher temperature than is possible in the furnace, and thus becomes far more completely carbonised, it is further stated that through the decomposition of the hydrocarbon, hydrogen is set free, and "the latter helps to eliminate the last traces of oxygen originally present in the cellulose. Traces of undecomposed cellulose can be detected in most filaments before treatment, but rarely afterwards." Without venturing to discuss the point about the exact manner and order in which the last traces of oxygen are removed from the carbon, we find it hard to understand how filaments, after the preliminary carbonisation process, still show signs, visual it is presumed, of undecomposed cellulose. We confess we have never noticed any such sign except in instances of very defective and incomplete carbonisation.

The description of the apparatus employed is as follows :—

The apparatus used to treat filaments differs greatly in the various factories, but figs. 1 and 2 illustrate, in diagrammatic form, and without details, a type of treating table largely used until recently in most factories, and still in use in the smaller ones. The working principle is the same in all, the improvements made having been chiefly in the line of more rapid manipulation.

A, A_1, fig. 1, are two heavy glass shades of bell shape with accurately ground edges resting on the rubber gaskets, B, B, B_1, B_1, and making air-tight joints with the brass plates, C, C_1. At D, D_1 are two heavy glass bottles containing gasoline (Rigoline) of the lightest quality, and connected by brass or glass tubes, E, E, with the shades as shown. F, F_1 are two pinch-cocks to adjustably compress short pieces of rubber tubing inserted in the tubes, E, E_1, the tubing being interrupted there for the purpose. These pinch-cocks regulate the supply of gasoline vapour to the shades. At H, H_1 are three-way plug-cocks with plugs J, J_1, each being connected to a shade by tubes G, G_1. As shown by dotted lines, G, G_1 enter at a different level from that of the other openings in the shell of the cocks and by an annular groove in the plug and a central hole communicate with the ports, I, I_1. At K is shown a tube leading to a very high vacuum air pump, and with a manometer at M, to indicate the degree of vacuum and also a barometer tube for comparison. L is a tube leading to an air pump of large capacity, and may be attached to a number of tables, and is employed to remove the bulk of the air

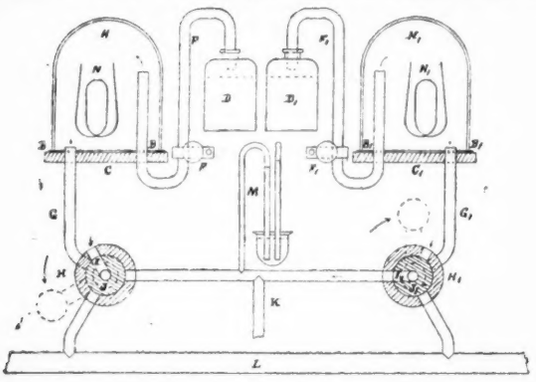


Fig. 1.

and relieve the high vacuum pump. The high vacuum pump is connected to only one treating table. At N, N_1 are shown the filaments to be treated, but without the clamps holding them and their electrical connections.

The operation of the table is as follows:—In the position of the cock, H, the port, I, is open to the air, and in consequence the shade, A, may be freely removed and an untreated filament inserted in the clamps, as at N. By means of a handle attached to the plug, J, and shown by dotted lines, the plug is revolved—with the arrow—until the port, I, communicates with L, which promptly removes the bulk of the air. A further revolving of J brings I to connect with K, completing the vacuum. Cock H_1 should previously have been turned so that the port, I_1, did not communicate with K, and the manometer mercury should then rise until about $\frac{1}{16}$ in. below the barometer level, otherwise there is a leak or the pump is not in perfect condition. The pinch-cock, F, may now be released slightly, permitting gasoline vapour to enter the shade, and after circulating around the filament go to the pump. This will depress the level of the mercury in the manometer, and F should be so regulated that the manometer drops $\frac{1}{2}$ to $\frac{3}{4}$ in. Current is then permitted to flow through the filament until treated and then automatically cut off, as will be explained below.

While N is being treated the operation just described for shade A is being repeated for shade A_1, up to the point where the high vacuum pump is put on, and when N has been cut out the plug-cocks are turned to the positions shown, and after regulating F_1 as F had

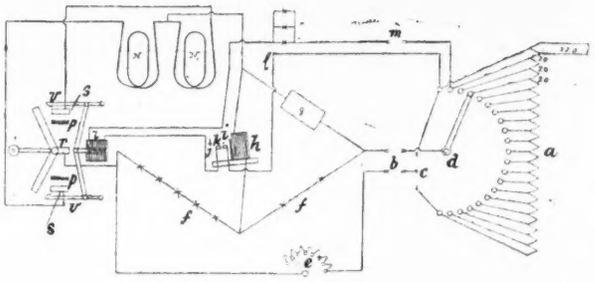


Fig. 2.

previously been done, current may be admitted to N_1, and a new raw filament put in place of N. A thick oil or a grease is used to smear the gaskets and the plugs of the cocks to make them air-tight, and in the case of the cocks, for lubrication also.

Reference to fig. 2 will show the electrical connections involved. While direct current may be and has been largely used for treating, alternating current has several distinct advantages, and its use will be described here. At *a* (fig. 2) is a transformer with a single coil, supplied with single-phase, alternating current at (say) 220 volts. The single coil has numerous leads of higher voltage, as shown, and with a potential difference between adjacent leads of 20 volts, except the first, which is 220 volts. These leads go to successive buttons of an arm selector, *d*. At *b* is a double-pole switch for cutting off the main circuit of the treating table from the transformer. It is evident that *b* could have been put in the main leads to the transformer, but it is often desirable that one transformer supply several tables, hence it is located as shown. At *c* is a single-pole, double-throw switch, enabling one pole of *b* to be connected to either the first or last button of *d*, the other pole of *b* remaining connected to the arm of *d*.

Between the first and second buttons (going clockwise) it will be seen that there is a potential difference of 220 volts, and between the second and third 20 volts, while between the first and third there is 240 volts, and so on. As shown, then, with *c* thrown to connect *b* with the first button of *d*, by moving the arm of *d*, voltages between 220 and 600 may be obtained by steps of 20 volts. If *c* is thrown to connect *b* with the last button of *d*, then, beginning with a difference of 20 volts and moving the arm counter-clockwise, voltages by 20-volt steps may be obtained up to 380 volts, and then to the last button, 600 volts. Thus any voltage may be selected for treating, within 20 volts and between 20 and 600 volts. In series with the table circuits is a rheostat, *e*, so proportioned as to make the finer adjustment of voltage when required. A lamp bank is sometimes substituted for *e*, but is not capable of as accurate adjustment as the rheostat.

A glance at fig. 2 shows that the filament being treated is in one side of a Wheatstone bridge with a proportion formed of incandescent lamps, *f*, f_1, a variable resistance, *g*, and a galvanometer, *h*. In place of *f*, f_1, an ohmic resistance or a reactance may be used, but lamps are very satisfactory, and consume but little energy. The plug resistance, *g*, is satisfactory if having a total of 111 ohms, varying by ·1 ohm. The galvanometer, *h*, is merely a coil of fine copper wire of about 80 ohms resistance, having an iron-wire core. The armature, *i*, is a strip of sheet-iron ordinarily held against the coil by the latter, and pivoted at the bottom, but when the filament is treated and the current in *h* approaches zero, the slight tilt of the coil permits *i* to be released and strike a small carbon point, *k*, mounted on a light spring, and forcing *k* against a similar carbon point, *j*, completing a local circuit, as shown, through the double-pole switch, *m*, lamps, *n*, and solenoid, *l*, the latter actuating the cut-out, *o*. As soon as the cut-out acts and the filament is disconnected the current through *h* becomes appreciable again and attracts *i*, permitting *j* and *k* to separate and break the local circuit.

The cut-out may take many forms, but is essentially a circuit-breaker, the trigger of which is not operated by its own current, but that of the local circuit. As shown, it is a single-pole, double-throw rocker switch, with springs, *p*, *p*, to tend to keep it open, and latches, *q*, *q*, to lock it in either closed position. These latches are opened by the solenoid, *l*, when the latter is energised, and the rocker released, breaking the circuit, in a manner that needs no description. The hinge, *r*, of the cut-out is connected to the rheostat and the resistance, while the two clips, *s*, *s*, are connected, one each to the terminals for holding the treating filament, one under each shade. The other two terminals, one under each shade, are connected together and to the galvanometer and plug resistance, as shown in the diagram.

When the filament is under the bell, the vacuum and gasoline being properly adjusted, the operator throws the handle of the cut-out to the right or left, according to the filament to be treated, completing the circuit through the blades, *s*, and at the same time

latching the cut-out shut. As the filament is being treated its resistance decreases and the two points on the "bridge" between which the galvanometer, h, is connected become nearly of the same potential and the magnetism of the coil, h, becomes too small to hold the armature, and it falls, actuating the cut-out. Variation of the plug resistance, g, will change the resistance of the treating filament when h operates. It is by manipulation of g and occasionally by shifting the proportions, f and f_1, that the resistance of the treated filament is regulated. The proper operating voltage for the lamp is determined by the resistance of the raw filament.

THE MUNICIPAL TRAMWAYS ASSOCIATION CONVENTION.

THE third annual Conference of the Municipal Tramways Association of Great Britain and Ireland was held at Liverpool on Tuesday, under the presidency of Mr. C. R. Bellamy, the general manager of the Liverpool Corporation Tramways.

The proceedings commenced at St. George's Hall, about 100 members being present, with a reception by Sir Charles Petrie, the chairman, and his fellow members on the Liverpool Tramways Committee. His address of welcome was short, hearty, and to the point. The warm thanks of the Association to Sir Charles and his Corporation were voiced by Councillor Smithson, of Leeds, and Bailie Paton, of Glasgow.

Mr. Bellamy's presidential address, of which we give an abstract below, was read by the secretary, Mr. J. M. McElroy (manager of the Manchester Tramways Department), as the president himself was at the time suffering from neuralgia.

Mr. John Young, of Glasgow, tendered the thanks of the meeting to Mr. Bellamy for an address, which, he said, was well worthy of his great reputation.

The report of the Executive Committee on the Standardisation of Tramway Accounts was next read by the secretary. Mr. Dalrymple, accountant, of Glasgow, who at last year's Conference presented a report on the same subject, which then caused an enthusiastic discussion, freely criticised several points in this year's report, with which he did not agree. The principle, he said, was right, but some of the details did not meet with his approval. The President did not think Mr. Dalrymple's opposition amounted to anything serious. Councillor Smithson (Leeds), himself an accountant, agreed entirely with the terms of the accounts, and the Secretary made out a good case for the adoption of the proposed form. After a little further discussion, the report was adopted.

Mr. P. Fisher, general manager of the Dundee City Tramways, was then called upon to read his paper on "Economy in Consumption of Current," and a discussion followed in which Mr. Le Rossignol (Newcastle), Mr. Spencer (Bradford), and Mr. Giles (Blackburn) took part; they were agreed that meters were at present not to be depended on within considerable percentages of error. Mr. Spencer spoke on the results of regenerative control in his town (Halifax); he has a good opinion of the system if the motors will stand the work. Mr. Travis (Southport) spoke in the same hopeful strain.

After Mr. Tittensor and others had addressed the meeting, Mr. Fisher briefly replied, and a very interesting exchange of views came to a close.

After a brief interval, Mr. J. B. Hamilton (Leeds City Tramways) read a paper on "Arrangement of Men's Duties," with which we shall deal in a later issue. Mr. A. L. C. Fell, the chief officer of the L.C.C. Tramways, read a paper on "Methods of Dealing with Mixed Systems of Traction," which we abstract in this issue.

On Tuesday evening the members of the Association dined together at the invitation of the Corporation Tramways Committee. The proceedings were resumed on Wednesday morning for the consideration of further papers, and yesterday (Thursday) was set apart for excursions.

Abstract of Address by Mr. C. R. BELLAMY, President.

Read September 27th, 1904.

As a preliminary, it is perhaps well that I should refer to the progress and work of the Association during the year. Since the Glasgow Conference, 11 corporations and 13 officials have been added to the roll, the Association now numbering 56 corporations and 71 managers or their assistants.

The standardisation of tramway accounts, which was referred at the last Conference to a joint committee of the Institute of Municipal Treasurers and Accountants and this Association, has been pushed forward with the vigour and care which the importance of the subject demanded. As a result of Conferences held at Nottingham and Bradford, a form of accounts has been evolved, which it is hoped will meet the requirement of enabling a fair comparison to be made of the working results of comparable undertakings.

The initial difficulty appeared to be to bring into line for the purpose, those undertakings which generate their own electricity, with those purchasing from another source, chiefly owing to the impossibility of dealing with capital charges in the revenue account. The trouble has been overcome by providing a supplementary statement setting forth the total energy costs in the case of self-contained undertakings, which will be comparable with the purchase price of the others.

The vexed question of differential depreciation has been left entirely open by carrying the balance from net revenue account to an appropriation account, where, after satisfying mortgage loans and sinking fund charges, any balance is allocated either to "reserve or renewal fund," or to "relief of rates."

The municipalisation of British tramways is making steady progress, about 215 additional miles of tramways having been applied for during the present session under an estimated cost of over £5,000,000, and provisional orders have been granted for about 34 miles, the estimated expenditure amounted to £307,380.

There is evidence of a better recognition of the principle underlying the early action of some of the large towns in arranging to acquire or operate the tramways of small adjacent authorities. It is increasingly clear that unity means strength and makes for success in tramway operations, and that what could not be obtained in small self-contained concerns, is readily secured under a combination extending the obvious advantages of a large undertaking over the whole of the area administered.

In this connection the subject of through running becomes increasingly important, because where combination or absorption cannot be arranged between adjoining districts, it will have to be considered.

The convenience of the public must always be placed in the forefront of traffic considerations, and just as the railway companies had to arrange through running very early in their history, so it is becoming a necessity with the ever extending systems of tramways, and it is desirable that this should be recognised and the principles controlling it settled by municipalities while their position for purposes of negotiation is strong.

In many cases where adjacent local authorities have failed to amalgamate for tramway purposes or link their systems, company promoters, recognising the necessity, have stepped in to provide the required connections; thus in the case of our own county, the South Lancashire Co. has connected, or obtained authority for connecting, 28 of the principal towns, bringing into one vast network, Liverpool and Manchester, which in turn is rapidly linking itself with an equally important combination of the principal towns of Yorkshire. It is unfortunate that the municipalities concerned do not control all these lines. Under a system of joint municipal ownership and more centralised management, their usefulness would be enormously increased.

The safeguarding of the financial stability of our undertakings must be considered. The returns for last year disclose the grave fact that nearly a dozen municipal undertakings ended the year with a deficit. It is probable that in most of these cases satisfactory results would have been obtained, if routes, stages, and fares, had been arranged on a basis suitable to the particular district concerned, rather than framed in an attempt to imitate those of large towns where continuous streams of point-to-point traffic alone render them possible.

In the large towns there are also signs of danger ahead. Great benefits have accrued under municipal control, routes, service, and speed of cars have been largely increased, with a reduction in many cases to less than one-half the fares under horse traction. A few years ago a house in the suburbs was regarded as in an eligible position if it were within 10 or 12 minutes' walk of a railway station, with a quarter or half-hourly service. To-day the tramways are within a few minutes' walk of everyone's door, with a practically-continuous service at all times of the day, and nearly all night, throughout the year, and prudence suggests that further concessions should be sparingly accorded until systems are consolidated, and their financial stability finally secured.

The ½d. stage, the 1d. universal fare, the all-night service, the season ticket, a multiplication of adjacent parallel routes, and lately ½d. fares for scholars, are all questions of most serious importance, which if carelessly dealt with, may at any time lead to disastrous results, and the obvious danger underlying them should suggest the advisability of increasing the sources of tramway revenue in directions less subject to popular attack.

It will, however, be remembered that the Tramways Act of 1870 provided for a general merchandise traffic, and while this class of business under company control has been practically ignored, it is probable that with interurban connections and joint municipal control, it would become a very useful source of additional revenue, as well as a great boon to important sections of the trade of the country.

It is satisfactory to note that the carriage of parcels has already been taken up on nearly one-half of our tramway systems.

Under this Act the Treasury was empowered to make loans for the construction of light railways, and free grants where the construction of such railways would benefit agriculture, or connect

fishing harbours with a market, or for the development or maintenance of some definite industry.

The object of the Government in passing the Light Railways Act, was avowedly in the interest of the small agriculturists and traders carrying on business at distances from the railway, which excluded them from the markets of the country.

The Light Railways Act has failed for two principles reasons—first, because the authorisation was not transferred to local authorities, and, secondly, largely consequent upon the first, because local authorities have not attempted to provide the railways.

It was at one time thought that goods traffic on tramways would interfere very largely with the revenue of railways, but it is found that tramways make a business peculiarly their own, while aiding largely in the development of railways.

In American towns, industrial life appears to follow the inter-urban tramways, and the land has been put to far more profitable use. Beet sugar factories have been erected in positions which would have been quite impossible but for the tramways, which ramify the district, collect the beet and convey it to the factory, and take the manufactured article from the factory to the steam railways, with which they are connected. Fruit-growing over a largely widened area is becoming highly remunerative; suitably arranged cars are run into the heart of the country at various points, where the freshly gathered fruit is collected and carried on trays, on adjustable shelves, right into the town markets, where it is on sale within two or three hours of gathering, from a distance of 20 to 30 miles.

In these towns the railway and tramway companies are working with the utmost harmony, their systems are connected, and often a number of railway cars are taken from the steam roads over the tramways by electric locomotives from point to point in the city to the great advantage of traders, who, by this means, secure much earlier and cheaper delivery.

I believe there is great scope for such a development of tramways in this country.

With the provision of such a system a farmer would be able to place his produce on a car always within easy cartage distance of his land, with a certainty that it would be promptly delivered into the market of one of the adjacent towns, whither he could accompany it for a few pence.

Traders and manufacturers could obtain or send light consignments of goods at any time under short notice to the connected towns, railways, or docks. They could replenish their supplies from the markets or cold stores by telephonic order practically in a few minutes, and the experience of America that such traffic on tramways assists rather than injures railway companies would be demonstrated in this country.

Coming nearer home, the Belgian light railways may be referred to. These lines are independent of the main lines, but in connection with them, are light rural railways running alongside or on main roads. Generally they are from 2 to 30 miles in length in the neighbourhood of most of the principal towns. About a quarter of the capital is furnished by the State, another quarter by the provinces, and the remainder by the National Light Railways Society, which is nominally a private company, but is practically controlled by the Belgian Government.

Agricultural, dairy, and general produce is carried at very low rates, milk is taken for distribution free of charge, and empties are returned free. It is stated that these railways have been a great success, and the maximum interest of 4½ per cent. paid.

A similar system is in operation in Italy and other parts on the Continent, indeed every country in Europe with the exception of England is doing all it can to develop light railways for the benefit of the vast areas of land untouched by railways.

The municipalities, acting in concert with county councils, have an opportunity of providing a system of light railways by making the most effective use of the public highways, which would render it possible, in addition to other obvious benefits, to produce in our own country the £40,000,000 worth of food stuffs which are at present imported annually, and would thus confer, both upon producer and consumer, immeasurable benefits, which should secure to our tramway undertakings the success which has followed the adoption of this class of haulage on the Continent, where, by the cheap concentration of produce, and combined bulk forwarding, it has been placed on the English markets under lower transit cost than can be secured by the British farmers operating within 20 or 30 miles of the same market.

I would suggest that this Association might effectively demonstrate its general usefulness by preparing a memorandum of a scheme for facilitating the provision of interurban tramways, in conference with the representatives of County Councils, for consideration by the Minister of Agriculture.

METHODS OF DEALING WITH MIXED SYSTEMS OF TRACTION.

By A. L. C. FELL, Chief Officer, London County Council Tramways.

(*Abstract of Paper read at Liverpool on Tuesday, September 27th*)

THE subject may be roughly divided under the following headings:—

1. Temporary mixed traction during reconstruction.
2. Mixed traction under normal conditions.
3. Mixed traction in connection with running powers.

The problem to be faced during reconstruction is a very complicated one. It is to maintain, as far as possible, a useful and fairly efficient service without incurring serious loss.

The following questions arise before the work of reconstruction is commenced:—

1. Will it be necessary to close the road for vehicular traffic?
2. What is the best method of arranging the work, so that the tramways can be kept running?
3. Can the work be carried out properly and expeditiously if a short length of single line is reconstructed, and temporary cross-overs are used?
4. Will it be advisable to lay a temporary track on one side of the road and reconstruct a fairly long length of single line?
5. Will it not be better to stop the tramways?

The answers to these questions depend entirely on local conditions.

In London in the majority of cases the roads have been kept open for vehicular traffic, and the tramways have with two exceptions been kept open, but the loss in receipts last year due to the disorganisation of the traffic during reconstruction amounted to upwards of £24,000.

Where the tramways have been kept running, a temporary track has been laid at one side of the road. In two instances the tramways were stopped during reconstruction. In the first instance the route was an unimportant one, and electrical running was not commenced until the whole route was complete; in the second instance, one track was reconstructed at a time: when about one-third of the route was completed, work was commenced on the other track: in this way half the roadway was kept open for vehicular traffic. Whenever possible, mixed traction and the necessity for changing cars has been avoided.

If the original system is a horse or a steam tramway, and it is desired to reconstruct for an overhead electric tramway system, it is advisable to complete the whole of a route before the electric cars are put in operation, and so avoid "Mixed Traction" if possible; but if it is a question similar to that which recently had to be dealt with in London, it is not possible. The special instance was as follows:—

A horse tramway originally ran from the Westminster and Blackfriars Bridges to Brixton. About 10 years ago a portion of this route was reconstructed and extended, and a cable system of traction was installed, as the gradients were considered too steep on the extension to be profitably worked by horse traction. For the convenience of the passengers, the horse cars on the other portion of the route were fitted with cable grippers, so that they could be run over the whole route; the change over at the junction of the two systems being made very rapidly. In 1903 the portion of the route operated by horses was reconstructed, and a conduit electric traction system was installed. Owing to obstructions in the roadway, it was not possible to carry the conduit sufficiently far to enable the cars on the cable and electric systems to be brought close to one another, and it was necessary to draw the cable cars over the intervening space by means of horses. The original intention was to temporarily operate the electric cars over the cable system, and they were fitted with cable grippers and plough-lifting devices, but it was found that the cable was not strong enough to draw the heavy electric cars, and it became necessary to transfer the passengers from the electric to the cable cars, and *vice versâ*. As this very mixed system was very inconvenient and expensive, it was arranged to reconstruct and electrify the cable portion on the conduit system.

The cable had to be stopped during reconstruction, and the question of operating the cars by horse traction was discussed, but as four horses would have been necessary to draw each car, it was decided, after very careful consideration, to stop the tramways altogether during reconstruction, but to allow the ordinary vehicular traffic to use one-half of the road, as the thoroughfare was a very important one. The work was carried out in this manner, and not only was a very heavy loss on the disorganised working prevented, but it was possible to open the first portion of the road in 6½ weeks, and a second portion in 1½ weeks, and the remainder in 3 weeks, or a total of 3½ miles of double track in 11 weeks from the date on which the cable tramways stopped running. The result, from the traffic point of view, is that the receipts from this portion of the route have been doubled, and the receipts on the portion of the road previously reconstructed for electric traction have been increased by over 25 per cent., clearly demonstrating that a through route not operated by mixed systems of traction is what the travelling public require.

The cost of operating the above route by horse and cable systems was 9·99d. per car-mile; by electricity, horse, and cable it was 7·92d. per car-mile; and now, by electricity only, it is 7d. per car-mile, including all charges for power supply. We hope that when we obtain the necessary power from our permanent generating station at Greenwich, the cost of operation will be reduced to less than 6d. per car-mile.

Some municipal authorities may think it advisable to permanently operate several different systems of traction, and under special circumstances, this may be the best policy to adopt, although, as a general rule, a uniform system is most easily and efficiently worked. Taking London as an example, where mixed traction has been somewhat freely used, and will still be used, although only to a limited extent, horse, cable, and electric traction have all been in operation at one time, and in one instance already mentioned, the whole of these systems were, for a short time, in operation on one route. The L.C.C. has abolished the only cable line which it possessed, and the majority of the horse lines in the South of London have been reconstructed, and are now worked on the conduit system. The remaining lines will very shortly be dealt with, and reconstructed either on the conduit or the overhead trolley system. If necessary, the Council will not hesitate to mix these two systems. The complications introduced present no unsurmountable difficulties to the management, as the method of changing from one system to the other is very simple and expeditious, the whole operation being carried out in about 15 seconds. The conduit plough has simply to

be wound up by a winch, and the trolley arm is released, and the trolley placed on the overhead line, the only drawback being that cars have to be fitted with both trolley standards and plough carriers; in other respects the equipment of the cars is identical. In London, in all probability, the conduit system will be installed in all crowded thoroughfares, and on every route which can be profitably operated. I only hope that, as time goes on, we shall be able to materially decrease the cost of construction on the conduit system, and also reduce the cost of operation, so that practically the whole of the London County Council's tramways may be on the conduit system. For London, I am convinced that the conduit system is the ideal system, and the only one that is likely to prove an unmixed blessing.

The London County Council are now constructing a shallow tunnel on the north side of the river between Southampton Street and the Victoria Embankment. It will only be possible to work single-decked cars through this tunnel, as it is only 13 ft. high. It will be necessary, so that full advantage may be taken of the tunnel, to run through cars from one end of the system to the other. To do this, the majority of the cars will have to be of the single-deck type, with vestibules, which can be either open or closed. The double-deck cars will be used for short-distance journeys and on other than through routes.

Local difficulties with regard to "mixed traction" may be easily dealt with. Special routes can generally be arranged on which each system may be operated, but "mixed traction" is a more serious question when through running over tramways belonging to outside authorities is contemplated, as not only have different systems to be dealt with, but the subject of standardisation has to be faced. Unhappily up to the present time there has been no uniformity; the so-called standard gauges are not identical. The sections of rails vary greatly, and in several instances the dimensions of the cars vary to such an extent that although the rails may be laid to a standard gauge a sufficient clearance cannot be obtained between the cars. A great deal is at present being done with a view to standardising where possible, but it will be a very long time before these standards can be introduced—in fact, I very much doubt if the standards will ever be uniformly adopted in this country. In numerous instances the authorities have decided to continue the development of the local tramway system, so that the various parts of the undertaking will be interchangeable. This can quite readily be understood when it is considered that when the majority of the undertakings were started, no definite standards were recognised, and each pioneer authority had to make its own standards.

A short time ago I saw no less than 12 systems of traction in operation in Paris in one day, as follows:—

Conduit; overhead trolley; accumulator; steam cars drawn by locomotive; superheated steam cars; gas cars; oil cars; horse cars; Diatto surface contact system; Dolter surface contact system; tube railway, third rail; electric locomotive drawing ordinary steam railway trains into passenger station.

Taking the first 10 of these as an example of what may be done on any tramway undertaking, the following arrangements might be made:—

The conduit cars could be run over the trolley surface contact and accumulator systems, but to do this the cars would have to be fitted with ploughs, trolley standards, and accumulators.

In certain cities in Germany the cars are equipped with both trolleys and accumulators, as overhead traction is not permitted in the most important thoroughfares; but the cost of operation is abnormal, and the working is very unsatisfactory. It would be less expensive to install the conduit system in the restricted area.

In Paris the overhead and conduit systems are extensively used in conjunction with one another, and the results are most satisfactory. A similar mixed system in Bournemouth also works satisfactorily.

There would be no difficulty in fitting up cars for trolley and surface contact systems, but it would be a more complicated matter to equip cars for the conduit and surface contact systems, as the plough and the necessary lifting gear takes up all the available space between the motors, and the surface contact skates would have to be divided, and very short.

Horse, steam, gas, oil, and other self-contained systems might be operated on any of the other systems, but the electrically-equipped cars would be useless on the lines operated by these systems unless the routes were electrically equipped throughout.

[Mr. Fell attached to his paper a tabulated statement consisting of a list of queries which he circulated amongst the members of the Association with a view to ascertaining what was being done with regard to "mixed traction" under various conditions. The replies show that nearly every local authority has tried to avoid "mixed traction." Very few authorities stopped running the tramways during reconstruction. In the majority of cases, short lengths of single line have been reconstructed, and temporary cross-overs have been used to keep the tramways open. Very few instances are given where through "mixed traction" is in operation on the same route.]

CARS: THEIR EQUIPMENT AND MAINTENANCE.

By John Aldworth, General Manager, Nottingham Corporation Tramways.

(Abstract of Paper read on Wednesday, September 28th.)

This is undoubtedly one of the most important matters with which tramway managers and their staffs have to deal, as it is the actual and visible source from which the revenue of the undertaking is derived.

The average passenger does not trouble himself about such matters as the design or equipment of the power station, and provided there is always sufficient power to run the car on which he is travelling, rests satisfied that everything is as it should be; but if the car is not quite to his liking, or the temperature inside does not exactly suit his particular ideas on the subject, he is often very much in evidence.

No attempt will be made in this paper to treat the subject at all fully. The writer touches only upon a few of what he considers to be the most important features, and his observations are chiefly a description of the methods in operation on the Nottingham system, the result of some 11 years' experience in the working of that and other electric tramway undertakings; they are intended only to provide a basis for discussion and comparison with the methods in operation on other undertakings.

Design of Cars.—Cars should be of a design and size most suitable for the safe and expeditious handling of the particular class of traffic to be dealt with.

For traffic in large towns, the single-truck car (50 to 56 passengers) is the most suitable. It gives a more frequent and a quicker service, and from an operating point the car is more easily handled, and can work its way through the ordinary traffic with much less risk of accidents. For a long distance and varying traffic over suburban lines, the large bogie car (80 to 100 passengers) has its advantages.

The reversed and ordinary types of staircase both have their advocates. For ensuring the safety of passengers, protecting motormen and conductors from the vagaries of the English climate, and utilising all the space possible for seating accommodation, the reversed type is undoubtedly the best, the chief drawback being that it to some extent obstructs the motorman's view of the traffic on one side; the writer has overcome this difficulty by inserting a small sheet of half-inch plate-glass in the riser of the staircase level with the motorman's head. This device has now been in use for a considerable time, and has proved very effective.

The efficient ventilation of the car is one of the things that until quite recently has not had sufficient attention devoted to it, and many of the earlier cars leave much to be desired in this respect. To remedy this defect as much as possible, the writer has had the four corner side ventilating windows, which were originally hinged at the bottom, pivoted vertically at the centre, so that the end of the ventilator nearest the platform swings outward, and the other end inward, thus giving two openings on each side of the car through which a supply of fresh air is admitted at the front, above the passengers' heads, the foul air being forced out through the two corresponding openings at the rear end. The size of the openings can be regulated according to the state of the weather.

With cars having rheostats fixed inside under the seats, the question of ventilation becomes still more important, and for this reason, if for no other, the writer considers all rheostats should be fixed in some outside position.

A folding step is being given a trial in some towns.

The writer does not touch upon such controversial subjects as top-deck covers, dry seats, wind shields, route indicators and life-guards, which have been so much in evidence.

Motors.—To ensure a satisfactory service, it is necessary that cars should be equipped with motors designed to meet the varying conditions of the particular system they have to operate, and be capable of developing sufficient power to enable them to climb the steepest gradient thereon without being unduly overloaded, as, although the initial cost may be lower, and the average consumption of current per mile kept a fraction less, with a smaller motor, the additional cost of repairs will more than counterbalance this, to say nothing of the extra risk of breakdowns on the road, with its consequent interruption of traffic. Given a properly designed and sufficiently powerful motor, the important thing is to see that it is well taken care of. This can only be done by having it systematically inspected, and maintained in its most efficient condition.

The writer has tried several methods of inspection and reporting upon the condition of the car motors, also of carrying out the repairs, and the following system has been adopted as a result thereof:—

The commutators, brushes and brush springs are examined nightly, and where any commutator shows signs of undue sparking or heating, it is carefully examined by the night foreman; and if no cause for it can be discovered, it is cleaned, and the car again put into service. Instructions are given to the chief motor inspector to test the car on the road during the following day; and if then found to be working unsatisfactory in any way, it is sent into the works to be thoroughly tested, and the defect put right. Armature and motor bearings, with their lubricating boxes, are also examined nightly, and any defect discovered is reported to the night foreman, who in every case uses his discretion whether such can be efficiently dealt with by himself, or whether the car shall be kept in for it to be dealt with by the day staff.

The writer has tried several kinds of white metal for lining motor and armature bearings, also solid gun-metal armature bushes of different mixtures; the latter, however, are not being renewed, but when worn down are bored out and run up with white metal instead of being scrapped. This has been found to answer well, besides effecting the following saving in the cost of renewals under this head:—Gun-metal bushes for one armature, including boring and turning, after allowing for their scrap value, 18s. 1½d.; boring out old bushes, filling with white metal and boring, 5s. 8d.; each subsequent relining and boring, 1s. 8d., or a difference of 16s. 5½d. in favour of white metal lining. The average life of the gun-metal bushes has been 25,086 miles, and that of the lined bushes practically the same.

A further advantage is found in the fact that, should a bearing

run hot, there is not the same danger of the shaft being scored with white metal, as is the case with gun-metal.

A metal is now being tried for lining, composed of three parts virgin spelter to one part block tin, which is considerably harder than any other white metal tried. This has not been in use sufficiently long to enable particulars to be given of the mileage to be obtained from bearings so lined; but so far they have given good results, the journals being in excellent condition, and the writer has no hesitation in saying they will give a considerably increased mileage.

Armatures, field coils and leads are thoroughly examined, tested and coated with insulating compound, also commutators turned up if required, every time the car passes through the repair shops for overhauling the bearings. The writer believes that considerable advantage would result from having commutators ground true instead of being turned up in the lathe, and is now experimenting in this direction. The condition of the armature bearings of each car is determined at least once a month by the night foreman, who tests the clearance between the armature and bottom fields, for which purpose he is provided with a set of steel feelers, numbered and varying in thickness from $\frac{3}{16}$ in. to $\frac{1}{32}$ in. The exact clearance of each armature is recorded and sent to the works superintendent, who decides when it is necessary for the bearings of a car to be renewed. After being repaired, each armature undergoes an insulation test; and before being put under a car, it is also tested at full load by being run for a period of 15 minutes in either direction. This shows up any defects in the repairs, and ensures its being in perfect working order when again put into service.

Controllers.—Controllers are all examined at the end of each day's work; all contacts are cleaned and thinly coated with vaseline, also adjusted or renewed as found necessary. The whole of the inside is kept perfectly clean, and the parts which require it are periodically coated with insulating compound, with the result that it is a very rare thing for a controller to give trouble.

Automatic Cut-outs.—These appliances from time to time gave considerable trouble on the road, and it was found advisable to calibrate them every time a car passed through the shops for overhauling. This has effectively dealt with that particular trouble.

Trolleys.—All trolleys are examined daily, whilst the poles are also tested for tension, and adjusted if found necessary, once a month. Experiments have been made with several kinds of trolley wheel bushes, and one composed of solid graphite has been found to give the best results. The bush, wheel, and spindle, which are submitted for inspection, have run 5,762 car-miles, and although the wheel is nearly worn out, the bush and spindle are very little the worse; they can be put into, and will last the life of, a second wheel. The cost of the bush is 1s. 2d., compared with 1s. paid for the metal-cased graphite bush, of which two are required during the life of one wheel.

The protection of passengers from electric shock is an important matter, and to ensure this as far as possible by the immediate detection of a leakage, ruby lamps are being used in the leakage circuit, so that they shall not be confused with the platform lamps. All leakage lamps and circuits, also lightning arresters, are examined and tested at least once a month.

Some undertakings have had their cars fitted with a patent "trolley earth indicator," which consists of a short-circuiting switch, held open by means of a fine wire fuse. This wire is connected in shunt with the switch, and as the whole apparatus is in circuit between the trolley base and earth, immediately upon the standard getting alive the fuse is melted and allows the switch to close by means of a spring. This connects the standard directly to earth, and causes an electric or mechanical bell to be set ringing.

Brakes.—The question of brakes is an important one on every undertaking, but where cars have to negotiate gradients of 1 in 11·5, and carry some of the heaviest rushes of holiday traffic over them, as is the case on the Nottingham system, it becomes a very important one indeed, and the writer considers that too much attention cannot be given to assure their being maintained in the highest possible state of efficiency. It is not proposed to discuss the merits or demerits of the various types on the market, but only to emphasise the importance of having motormen properly instructed in the best way to use the brakes at their disposal, and of a systematic inspection and overhauling of such brakes by trained and competent men. Money so spent can be considered as a first-class insurance premium against accidents. All the cars under the control of the writer are equipped with either a mechanical or magnetic track brake, in addition to the ordinary ratchet wheel brake, all of which are carefully examined nightly, and the necessary adjustments or renewals executed; in addition to this, all the brakes of every car are examined and tested once a month, under the direct supervision of the works superintendent, or his chief assistant. A number of the cars are fitted with an automatic adjusting device, for keeping the blocks set to the proper distance from the wheels. These are acting very satisfactorily, and effect a saving in labour. During the time the Nottingham electric system has been in operation, nearly four years, there has not been a single case of a car running away, which of itself fully justifies the great care that has always been bestowed upon this part of the equipment.

Wheels and Axles.—As to the vexed question of steel *versus* chilled iron wheels, sufficient has been heard of this recently to excuse a comparison of their merits being entered upon in this paper. Like many others, the writer has been experimenting with steel-tired wheels, but considerable difficulty has been caused by the flanges. Possibly this may be attributed to the fact that they have a large number of curves to negotiate. On one route of about three miles there are seven curves of a radius ranging from 45 to about 60 ft. Very good results have been obtained from chilled wheels, some having run upwards of 45,000 miles, the average life being 34,124 miles, and in only one case has a pair been trued up in the grinding machine. We have a good permanent way, which doubtless accounts to a large extent for our comparative freedom from the troubles connected with broken axles and wheel flanges. For single-truck cars, the tendency appears to be in favour of increasing the size of the axles. This is undoubtedly a step in the right direction, as a much larger diameter might be used with advantage, not only for the additional strength, but also to obtain a larger bearing surface. The writer is not in a position to discuss the question of broken axles, having had but one failure in 6¾ million miles run by the cars.

Inspection and Reports.—To avoid as far as possible break-downs on the road, and for assisting motormen who might be in difficulties, a motor inspector is stationed at a point on the system where all the lines converge. Defects reported to him are dealt with on the road, or the car changed if necessary, and a daily report of all such cases is made by him He is in direct telephonic communication with each depôt, which enables him to arrange for the changing of cars at the most convenient point. Definite instructions have also been given that under no circumstances shall a car be allowed to remain in service with its brake in the slightest degree defective. In addition to this, every motorman before going off duty enters in the report book at his depôt particulars of any repairs requiring attention, and attaches his signature thereto. These reports are compared with that of the motor inspector, and a return of all repairs executed during the night is handed in to the works superintendent each morning.

The running condition of each car is tested periodically by the chief motor inspector, who himself operates it both up and down the heaviest gradient of the route upon which it is running, and the result thereof is also reported to the works superintendent. This has proved a very effective way of detecting faults, and having them dealt with on the "stitch-in-time" principle, as the inspector being trained to look for defects, and able to compare the running of the different cars over the same route, is much better qualified to detect incipient troubles and express an opinion thereon than is the average motorman, whose reports are often misleading and require to be examined with great care.

None but brake and trolley renewals and light repairs are executed at the branch depôts, all cars requiring other attention being sent to the works, by which arrangement the work is carried out under the most economical, expeditious, and efficient conditions.

Equipment of Repair Shops.—To deal with the repairs and up-keep in an economical and satisfactory manner, it is necessary that the shops should be equipped with up-to-date labour-saving machinery, testing machinery, and instruments; and for an undertaking operating from 100 to 150 cars using chilled wheels, the following has been found adequate:—

In the fitting shop: A five-ton electric travelling crane, two lines of shafting—each belt-driven by a 10-H.P. motor—10-in. screw-cutting gap lathe, 6-in. screw-cutting lathe with universal chucks, vertical wheel-boring machine, wheel-grinding machine, hydraulic press, radial drilling machine, small sensitive drilling machine, universal shaping machine, power hack saw, screwing machine, acme grinder, grindstone, moulding jigs for lining bearings, lifting jacks, and armature bogies, with various small tools as found necessary.

In the armature room: Armature stands, wire drums with tension brakes, furnace, formers, taping machine, drying oven, testing machine, and insulation testing set.

In the smiths' shop: Two forges, anvils, swage blocks, set of levelling blocks, small power hammer, and "Roots" blower driven by independent motor.

In the woodworking shop: Line of shafting driven by a 5-H.P. motor, circular saw bench fitted with boring apparatus, band saw, planing machine, mortising machine, and universal trimmer.

The buildings should be constructed, and the machinery arranged, so as to avoid undue handling of the car and different parts of the equipment, whilst undergoing repairs. Pits should extend the full length of each track, and communicate with each other, also be fitted with hydraulic platforms for removing wheels and axles from under the cars. To obtain the best results, all the shops should be concentrated as far as possible, have plenty of light and ventilation, and be provided with good heating and sanitary arrangements.

General.—To enable a check to be kept upon the repairs bill, which by its tendency to increase appears to be always trying to take a more prominent place in tramway matters, also to decide upon the best methods and materials to be used in connection therewith, full and accurate records should be kept of all matters connected with the running, inspection, and repairs of the cars; as only by a careful study of these can the many points coming under consideration be adequately dealt with.

Comparisons of the methods of working, and also the operating expenses of different systems, are always interesting, if not conclusive. A manager whose system consists mainly of steep gradients has reason to feel envious of the low cost, to say nothing about the minimised risk of accidents, at which other systems can be operated whose routes are all practically level. Not only is the consumption of current much heavier with steep gradients, but the writer finds the cost of maintenance also increases in practically the same ratio. No conclusions, therefore, should be drawn from such comparisons, without taking into consideration the many different conditions under which the undertakings have to be operated.

Tottenham Electric Lighting.—The U.D.C. has resolved to invite offers for the supply of electricity in bulk or otherwise. Proposals are required by October 21st.

ALUMINIUM ELECTRICAL CONDUCTORS.*

By RODERICK J. PARKE.

In 1902 the world's production of aluminium was 8,000 tons, whilst that of copper was 497,000 tons. Later statistics show an increase in the output of the former metal, due, probably, to its increasing use for electrical purposes.

The following particulars are of primary importance in the comparison of aluminium and copper:—

	Aluminium.	Copper.
Specific gravity	2·68	8·93
Conductivity (Matthiessen standard) ...	62	97
Tensile strength (per sq in.)	28,000	45,000
Coefficient of linear expansion (per ft.)...	·0000128	·0000093
Coefficient of temperature resistance ...	·00114	·00117
Modulus of elasticity	9,000,000	14,000,000

And from these figures the following particulars may be calculated:—

	Aluminium.	Copper.
Cross-section for equal resistance	1·56	1
Diameter for equal resistance	1·25	1
Weight for equal resistance	0·47	1
Tensile strength for equal resistance ...	0·96	1
Price for equal cost	2·13	1
Rate of temperature change (resistance) ...	1·0	1

Thus the important fact is shown that aluminium possesses less than half the weight of copper for equivalent resistance. This is a great advantage, and results favourably to aluminium in three ways:—

1. Lower cost of transmission.
2. Reduced cost of erection.
3. The cost of maintenance is less, on account of the reduced strain on the poles, insulators, &c.

An additional advantage of aluminium is that, on account of its peculiar nature, it retains, for years, some of the grease used in drawing, and this grease prevents any great amount of sleet from forming upon it.

To balance the advantages cited, there are the following disadvantages:—

1. Difficulty in making joints.
2. Greater sag, due to larger coefficient of expansion.
3. Insufficient strength for conductors of the sizes used for telephone and telegraph wires.

For jointing aluminium wires smaller than No. 0000 B. and S. gauge, the two ends are inserted into a piece of flattened tube, and the tube given 2½ twists by means of two pairs of ordinary wireman's pliers. This makes a perfectly satisfactory joint of low resistance, and which is as strong as the wire jointed.

Larger sizes are conveniently jointed in any of the three following ways:—

1. By means of the ordinary dove-tail cable splice.
2. By means of terminals compressed on the ends of the cables at the factory, these terminals being threaded, and thus adapted to be united in the field by a threaded stud.
3. By inserting the ends to be jointed into a cast sleeve, and compressing the sleeves between dies in a small portable press.

The sag of aluminium wires is not as much greater as might be expected, however, because the lower modulus of elasticity of aluminium causes it to contract more as the strain is relieved from it, and because the weight of aluminium, for equal areas, is only three-tenths, while the strength is two-thirds that of copper. This causes aluminium to start with a smaller minimum sag than copper.

The third objection for aluminium applies only for telegraphs, telephones, and similar work. The smallest size of aluminium wire which it would be advisable to use in pole line work is No. 4 B. & S. gauge, which has a breaking strength of about 1,000 lbs.

The principal uses of aluminium conductors have been for railway feeders, high tension transmission work and bus-bars. For power transmission its use has become very extensive, the longest and largest transmissions in the world are now made over aluminium. The following list and data may be of interest:—

Locations.	No. of cables.	Miles per cable.	Circular mils area of each.
Niagara Falls to Buffalo	3	20	500,000
Shawinigan Falls to Montreal ...	3	85	183,708
Electra to Mission San Jose ...	3	100	471,034
Colegate to Oakland	3	144	211,000
Farmington River to Hartford ...	3	11	336,420
Lewiston, Me.	3	3·5	144,688
Ludlow, Mass.	6	4·5	135,247

Aluminium conductors were first placed on the market as solid-drawn wire, but subsequent experience has demonstrated that the tensile strength of any given aluminium conductor is increased somewhat by building it up of several strands wound together.

As regards the respective capacity, self-induction, and skin effect of aluminium and copper when used for alternating currents, they compare in the following way:—As aluminium is one quarter greater in diameter than equivalent copper, it is evident that the self-induction of the line will be the same when the aluminium wires are separated 25 per cent. more than the copper wires. The static capacity of the aluminium will be approximately 5 per cent. greater than that of copper with the same spacing. The skin effect will be the same with either metal, since the effect of the greater diameter of the aluminium is exactly offset by its greater specific resistance, in making the calculations for the percentage increase of the resistance.

The average market prices of the two metals are such that from 5 to 15 per cent. can be saved by the purchase of aluminium.

* Abstract of a paper read before the Convention of the Canadian Electrical Association, held in Hamilton, Toronto, June, 1904.

ENERGY LOSSES IN MAGNETISING IRON.*

By W. M. MORDEY and A. G. HANSARD.

In 1890, when faced with the necessity of getting iron of definite quality for transformers, the author adopted the plan, previously advocated by Mr. Swinburne, of measurement of the total loss by a wattmeter, if possible under the actual conditions of working. For workshop convenience a fixed point of comparison was chosen, at which all iron was tested. This was stated as follows:—"The loss in iron sheets or stampings ·014 in. thick made up in the form of a transformer and tested by a wattmeter should be 0·38 watt per lb. at a magnetisation of 2,500 B and at 100 periods per second. At that time the custom was to order 'best soft Swedish charcoal iron carefully annealed,' but such iron varied in its losses under the defined conditions from little more than ·3 watt per lb. up to about ·6, causing serious engineering difficulties. Although further lamination was recognised as desirable, it was found to be difficult to get sheets thinner than ·014 in., so that thickness was adopted for all purposes. The low magnetisation of 2,500 B was chosen as a point for comparison, because it was desired to keep down the no-load losses and the heating of 100-period transformers. For lower periodicities, higher densities may, of course, be used.

The separation of hysteresis and eddy losses by calculation is based on the assumption that hysteresis varies directly as the periodicity, and as $B^{1.6}$, the latter or Steinmetz ratio being the value which Mr. Steinmetz, working from Prof. Ewing's results and from observations of his own, found to express the relation between hysteresis and density. The eddy currents are always assumed to vary as the square of the magnetisation, the square of the periodicity, the square of the thickness, and inversely as the resistance of the iron. As the eddies in ordinary thicknesses of plates are by no means negligible, it becomes a matter of some difficulty to reconcile these assumptions with the facts, especially when the total loss curve is found to be a $B^{1.6}$ curve, as often happens.

In order to examine the effect of increase of thickness of iron sheets, the authors have tested some transformer stampings made from sheets of three different thicknesses of the same quality of iron. The thickness of the three samples, A, B and C, calculated from the weight, was 0136 in., 0189 in. and 0254 in. Gauging with a micrometer showed a variation of about ·001 in. in actual thickness of the plates. Samples of these plates were tested on a Ewing hysteresis tester by a very experienced experimenter, who obtained the results, ·39, ·38 and 40. The stampings were made up in transformer form, about 11·7 lb. being used in each case, and wattmeter tests of the total loss were made at 50 and 100 ~, at six values of B in each case. After deducting the losses in the winding, the iron losses were plotted in curves, which are all steeper than $B^{1.6}$ curves, and therefore do not present the same difficulty.

The results show very clearly that even with these thin sheets and moderate densities the eddy loss is of the same order of importance as the hysteresis.

For the 0136 and ·0169 sheets the increase in eddies is practically proportional to $(\text{thickness})^{-2}$, that is, the loss with the latter is nearly double that with the former. But as between ·0136 and ·0254 the average increase is less than $(\text{thickness})^{-2}$ by about 30 per cent. It is about 2·5 instead of 3·5 times greater.

As regards the relation between B and eddies, the tests on the whole do not indicate any marked departure from the B^2 assumption. As regards periodicity, the averages show that the increase is as 1 to 3·46, instead of 1 to 4. We suggest that the result showing that eddies increase less quickly than $(\text{thickness})^{-2}$ and $(\text{periodicity})^2$ may be reasonably explained by assuming that the eddy circuits have self induction. If this is so, it prevents the possibility of dealing with them simply by Ohm's law, as hitherto seems to have been the practice.

The authors would summarise their conclusions as follows:—(1) In determining the magnetic quality of iron sheets, eddy current losses, though often neglected, are by no means negligible, and are often as important as hysteresis. (2) The simple laws generally assumed to be followed by hysteresis and eddies are found, as often as not, to be rather widely departed from and consequently with such a variable material as iron, the only satisfactory method of predicting losses is to make wattmeter tests of samples, as nearly as possible under the working conditions.

* Abstract of paper read before the British Association at Cambridge.

NEW PATENTS APPLIED FOR.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

19,243. "Improvements in and relating to electric generator locomotives and the like." A. Dickinson and J. Mannheim. September 6th.

19,609. "An electro-magnetic variable speed gear for motor-cars and other purposes." A. G. Seaman. September 12th.

19,611. "Improvements in controlling apparatus for electric motors." K. Klinkenberg. September 12th. (Complete.)

19,646. "Improvements in or relating to electrolytic electricity meters." The Bastian Meter Co., Ltd., C. O. Bastian and C. H. Churchill. September 12th.

19,647. "Improvements in chains for pendant electric light fittings." F. C. Smith and F. H. Davis. September 12th.

19,748. "Improvements in or relating to apparatus for supplying alternating electric current." A. F. Berry. September 13th.

19,749. "Improvements in or relating to apparatus for use in the distribution of alternating electric current." A. F. Berry. September 13th.

19,762. "Improvements in and connected with points for electric tramways and light railways on the conduit system." R. Ames. September 13th.

19,822. "Improvements relating to starting resistances for electric collector meters." M. Latour. September 14th. (Date applied for under Patents Act, 1901, September 16th, 1903, being date of application in France.) (Complete.)

19,823. "Improved means of protecting 'live' rails on electric railways." J. J. Hodgson. September 14th.

19,888. "A means by which the points of an electrical railway or car line may be operated from an approaching car." T. Miller. September 15th.

19,818. "Improvements in electric conduit systems." A. G. Hyslop. September 15th.

19,883. "Improvements in electric igniters." E. Eisemann. September 15th. (Complete.)

19,885. "Improvements in and relating to electric controllers." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 15th.

19,886. "Improvements in electric railway systems employing sectional conductors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 15th.

19,887. "Improvements in and relating to safety devices for electric signalling systems." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) September 15th.

19,889. "Improvements in, and relating to, electro-magnetic mechanism." The British Thomson-Houston Co. (The General Electric Co., United States.) September 15th.

19,898. "Improvements in primary batteries." H. E. Blackburn. September 15th.

19,917. "Improvements relating to push buttons and the like for electric bells and similar services." E. G. Harcourt. September 15th.

19,923. "Improvements in electro-magnets, having polarised armatures for use in apparatus operated by reversals of electric current." A. Hommel. (Date applied for under Patents Act, 1901, December 21st, 1903, being date of application in Switzerland.) September 15th. (Complete.)

19,958. "Improvements in third-rail systems of electrical traction." E. E. Clark. September 16th.

19,993. "Improvements in shunts for electrical instruments of the moving coil type." Evershed & Vignoles, Ltd., and E. B. Vignoles. September 16th.

19,997. "Improvements in, or relating to, apparatus for regulating the voltage of electrical circuits." H. R. Stuart. (Date applied for under Patents Act, 1901, September 26th, 1903, being date of application in United States.) September 16th. (Complete.)

19,998. "Improvements in current-collecting devices for electric generators and motors." K. F. Ilers. (Date applied for under Patents Act, 1901, September, 1903, being date of application in United States.) September 16th. (Complete.)

19,999. "Improvements in electrical transformers." C. Le Geyt Fortescue. September 16th. (Date applied for under Patents Act, 1901, September 30th, 1903, being date of application in United States.) (Complete.)

20,000. "Improvements in or relating to coils for electrical apparatus." C. Le Geyt Fortescue. September 16th. (Date applied for under Patents Act, 1901, September 30th, 1903, being date of application in United States.) (Complete.)

20,001. "Improvements in systems of electrical distribution." P. M. Lincoln. September 16th. (Date applied for under Patents Act, 1901, September 30th, 1903, being date of application in United States.) (Complete.)

20,007. "Improvements in supports for incandescent electric lamps." A. Romain and J. D'Ayguesvives. September 16th. (Complete.)

20,009. "Improvements in and relating to electric telegraphy." A. Muirhead. September 16th.

20,010. "An improved holder for electric lamps." C. C. Ragnart and The Hunter Electric Candle Lamp Co., Ltd. September 16th.

20,019. "Improvements in electric arc lamps." W. J. Davy. September 16th.

20,029. "Effecting the electric propulsion of navigable vessels." B. H. Thwaite. September 17th.

20,105. "Improvements in electrical signalling apparatus for fire calls and the like." E. L. Pinching and W. H. Walton. September 17th. (Complete.)

Electrical Ignition Apparatus applicable to Internal Combustion Engines. A. Eckstein and H. J. Coates. 3,244. February 11th.

Electrotype Blocks. J. W. Cornelius. 3,396. February 13th. (Date applied for under Patents Act, 1901, February 13th, 1902, being date of application in United States.) (Complete.)

Means for Controlling Electric Circuits. H. Leitner and R. N. Lucas. 3,425. February 13th.

Lighting Railway Trains. J. F. McElroy. 3,620A. February 16th.

Regulating Devices for Electrically-Propelled Vehicles. J. S. Raworth. 3,657. February 16th.

Regulating Devices for Electrically-Propelled Vehicles. J. S. Raworth. 3,658. February 16th.

Electric Light Safety Relay. A. H. Johnson and F. R. S. Bircham. 3,783. February 18th.

Wireless Signalling. L. de Forest. 3,876. February 18th.

Wireless Signalling. L. de Forest. 3,876A. February 18th.

Improved Contact Stud and Fixing for use with Surface Contact Systems of Electric Traction. W. Griffiths and B. H. Bedell. 3,988. February 18th.

Appliances for the Prevention of the Racing of Marine Engines. J. MacLean. 4,393. February 25th.

Electric Cables. A. P. Hanson. 4,681. February 27th.

Arc Lamps. E. A. Carolan. (General Electric Co., U.S.A.) 4,645. February 27th.

Telephone Receivers. W. G. Heys. (The Hutchison Acoustic Co., U.S.) 4,704. February 28th.

Electric Batteries. J. Portalier. 5,891. March 13th. (Date applied for under Patents, Act, 1901, September 13th, 1902, being date of application in Belgium.) (Complete.)

Switch for use in Charging Storage or Secondary Batteries. W. G. Heys. (The Hutchison Acoustic Co., U.S.) 5,918. March 14th.

Electric Sparking Devices Especially Intended for Firing the Charges in Internal Combustion Engines. E. F. Bradley and H. Edmunds. 5,989. March 14th.

Electrical Fuse Boards. J. Moores and D. Ashton. 6,016. March 16th.

Electrical Switches. G. Sperryn and W. H. Wood. 6,249. March 18th.

Electric Controllers. H. von Kramer. 6,337. March 19th.

Carbon Holders for Electric Arc Lamps. T. Hamilton-Adams. 6,405. March 19th.

Electric Indicators. E. Sadler. 6,415. March 19th.

Bowie's Electro-Therapeutic Special High Frequency Apparatus. J. H. Phelps and J. C. Bowie. 6,477. March 20th.

Electric Controllers. E. A. Carolan. (The General Electric Co., U.S.) 6,483. March 20th.

Alternating Electric Current Transformers. E. A. Carolan. (The General Co., U.S.) 6,484. March 20th.

Electric Reactance Coils. E. A. Carolan. (The General Electric Co., U.S.) 6,485. March 20th.

Induction Electric Motor Armatures. E. A. Carolan. (The General Electric Co., U.S.) 6,486. March 20th.

Alternating Electric Current Induction Motors. E. A. Carolan. (The General Co., U.S.) 6,487. March 20th.

Alternating Electric Current Transformers. E. A. Carolan. (The General Electric Co., U.S.) 6,488. March 20th.

Electric Switches. E. A. Carolan. (The General Electric Co., U.S.) 6,490. March 20th.

Alternating Electric Current Motors. E. A. Carolan. (The General Electric Co., U.S.) 6,491. March 20th.

Electric Metering Systems. E. A. Carolan. (The General Electric Co., U.S.) 6,493. March 20th.

Controlling the Division of Load Between Synchronous Electric Motor-Generator Sets. E. A. Carolan. (The General Electric Co., U.S.) 6,494. March 20th.

Dynamo-Electric Machines. E. A. Carolan. (The General Electric Co., U.S.) 6,500. March 20th.

Winding Electric Coils. E. A. Carolan. (The General Electric Co., U.S.) 6,501. March 20th.

Support for the Receiver or Hand Set of Combined Table and Wall Telephones. B. Brander. 6,660. March 23rd.

Telephonic or Electric Signalling Apparatus. J. Higginbottom. 6,671. March 23rd.

Controllers for Electric Circuits. T. von Zweigbergk. 6,718. March 23rd.

Electric Ignition for Internal Combustion Motors. H. T. Dawson and H. A. Dawson. 6,723. March 23rd.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1903.

Ears for Trolley Wires of Electric Tramways. C. Close and J. Ramsey. 2,857. February 6th.

Couplings for Conduits for Electric Conductors. D. S. Munro. 2,930. February 7th.

Electric Brakes for Wheels. R. W. James. (The Algonquin Electric Brake Co., United States.) 3,170. February 10th.

Ears for Overhead Trolley Wires. A. Richardson and W. H. Allen. 3,226. February 11th.

Manufacture or Repair of Articles made of Quartz.

—Dr. P. Askenasy, of Pansdorf bei Liegnitz, has taken out a German patent for a method of effecting the above. A quantity of quartz sand is laid upon a suitable support of the same material, and fused into the desired shape by means of an electric arc, which is moved over the surface of the mass as it melts. When such an object as a basin is being made, the quartz is first mixed with some agglutinant, such as 1 per cent. of starch solution, petroleum residue, lavender oil, or the like. The arc is struck between sloping electrodes of small diameter, high voltages being employed; and in order to hinder their rapid consumption, the operation is conducted in an indifferent atmosphere, such as one of carbon monoxide. In certain cases it may be desirable to add to the quartz some metallic oxides, like alumina, stannic acid, titanic acid, &c., as these reduce the melting point; but the quantity introduced must be too small seriously to affect the coefficient of expansion. During the fusion a dust of quartz may be allowed to fall round the arc, for in this manner any holes produced are instantly sealed up. The same process is available for the repair of any cracks or flaws in articles already constructed of quartz.